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(71) Applicant : **SONY CORPORATION**
6-7-35 Kitashinagawa
Shinagawa-ku
Tokyo 141 (JP)

(72) Inventor : **Okazaki, Toru, c/o Intellectual Pro. Div.**
Sony Corporation,
6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)
Inventor : **Yagasaki, Yoichi, c/o Intellectual Pro. Div.**
Sony Corporation,
6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)
Inventor : **Muramatsu, Yasuhiro, c/o Intellectual Pro. Div.**
Sony Corporation,
6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)

(74) Representative : **Cotter, Ivan John et al**
D. YOUNG & CO.
21 New Fetter Lane
London EC4A 1DA (GB)

(54) **Coding and decoding methods and systems.**

(57) Input data is efficiently variable length coded by using a variable length coding table selected from among a plurality of variable length coding tables (23C, 23D) in accordance with a coding efficiency. It is thus possible further to improve variable length coding efficiency as compared with a case using only one variable length coding table. As a result, when generating information content equal to that generated by using only one variable length coding table, it is possible to process quantized data with a smaller quantization size and further to improve the quality of information transmitted as coded data.

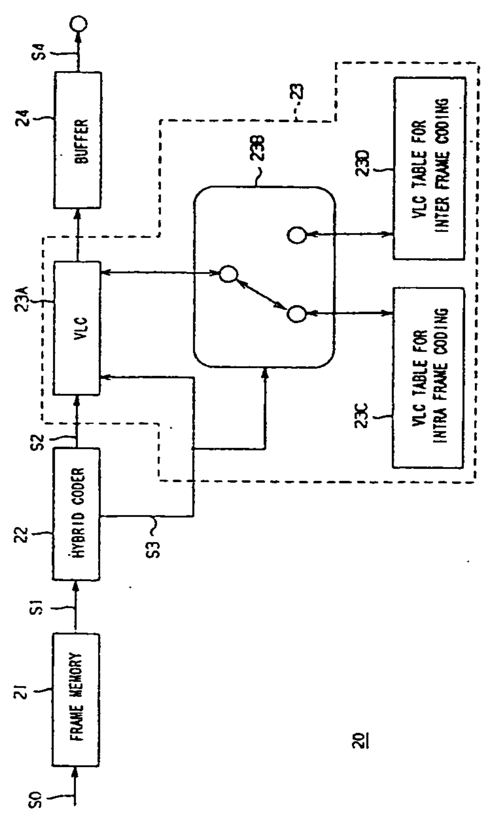

FIG. 5

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EUROPEAN SEARCH REPORT

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EP 93 30 8349

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	INTERNATIONAL ORGANISATION FOR STANDARDIZATION - ISO/IEC JTC1/SC2/WG11, 13 November 1991 pages 1 - 74 SOURCE: MATSUSHITA 'MPEG Document 91/217' * page 3, line 1 - line 8 * * section 2.13 on page 13 *	1-16	H04N7/13 H04N7/133
X	EP-A-0 469 835 (CANON KABUSHIKI KAISHA) * claims 1,7; figures 5A,5B *	1,2,9,10	
X	PATENT ABSTRACTS OF JAPAN vol. 14, no. 553 (E-1010) 7 December 1990 & JP-A-02 237 368 (SHARP CORP.) 19 September 1990 * abstract *	1,9	
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 475 (E-1273) 2 October 1992 & JP-A-04 170 187 (OLYMPUS OPTICAL CO. LTD.) * abstract *	1-16	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, vol.38, no.1, February 1992, NEW YORK US pages XVIII - XXXIV G.WALLACE 'The JPEG still picture compression standard' * page XXIII, left column, line 26 - line 36; figures 1,2 *	1-16	H04N
P,X	EP-A-0 542 474 (AMERICAN TELEPHONE AND TELEGRAPH COMPANY) * page 7, line 30 - line 39 * * page 15, line 36 - page 16, line 10; figure 10 *	1-16	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 October 1994	Giannotti, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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(71) Applicant : **SONY CORPORATION**
6-7-35 Kitashinagawa Shinagawa-ku
Tokyo 141 (JP)

(72) Inventor : **Okazaki, Toru, c/o Intellectual Pro. Div.**
Sony Corporation, 6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)
Inventor : **Yagasaki, Yoichi, c/o Intellectual Pro. Div.**
Sony Corporation, 6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)
Inventor : **Muramatsu, Yasuhiro, c/o Intellectual Pro. Div.**
Sony Corporation, 6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)

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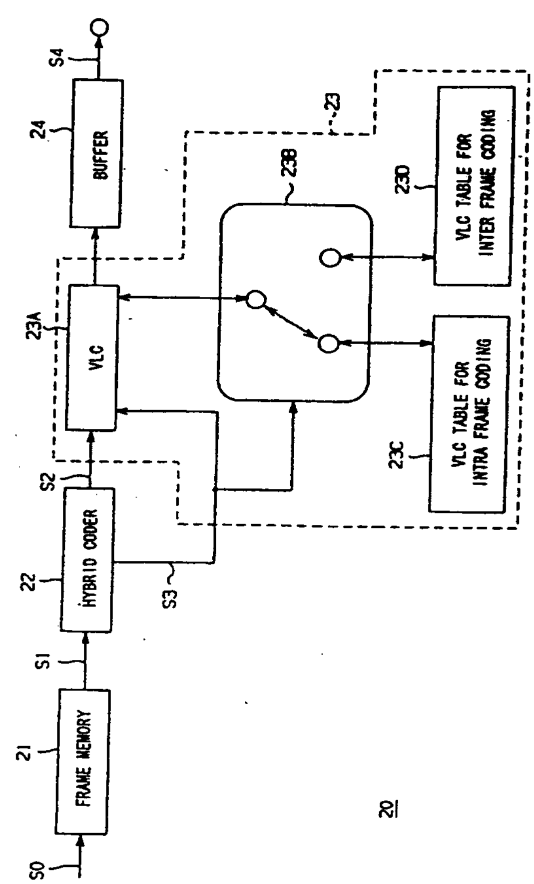

FIG. 5

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Jouve, 18, rue Saint-Denis, 75001 PARIS

This inv ntion relates to coding and decoding methods and systems, and is applicable, for example, to variable length coding and decoding methods and systems for orthogonally transformed picture signals.

Video signal transmission systems for transmitting video signals in the form of motion pictures to remote places, such as a video conference system and videophone, have been proposed. In the video signal transmission systems, video signals are coded by using line correlation and inter frame correlation of a video signal in order efficiently to use a transmission path, thereby improving the transmission efficiency of significant information.

For example, intra frame coding uses the line correlation of video signals. Therefore, as shown in Figs. 1A and 1B, when transmitting pictures PC1, PC2, PC3, ... at time points $t = t_1, t_2, t_3, ...$, constituting motion picture, the picture data to be transmitted is one-dimensionally coded in the same scanning line before transmitting the picture data.

Inter frame coding improves compressibility by using the inter frame correlation of video signals to obtain picture data PC12, PC23, ... having differences in pixel data between successively adjacent pictures PC1 and PC2, PC2 and PC3, ...

Thereby, the video signal transmission system is constituted to code the whole picture data for pictures PC1, PC2, PC3, ..., with high efficiency into digital data of much less quantity than the picture data compared with the case in transmitting the picture data, and send the digital data to a transmission path.

Fig. 2 shows how a picture sequence is intra frame coded or inter frame coded and transformed into three types of frames (macroblock) such as an intra frame predicted frame, forward inter frame predicted frame, and forward, backward, bidirectional inter frame predicted frame. In Fig. 2, 15 frame periods (frames F0 to F14) are used as one unit for coding.

For this example, the frame F2 is intra frame coded and is called "an intra picture". The frames F5, F8, F11, and F14 are predicted only by the frames F2, F5, F8, and F11 located ahead of the above frames respectively, and are called "predicted pictures".

The remaining frames F0, F1, F3, F4, F6, F7, F9, F10, F12, and F13 are predicted by frames located ahead of the above frames, those located behind the above frames, or those located at the both sides of the above frames as well as inter frame coded, and are called "bidirectional pictures".

Fig. 3 shows a video signal transmission system. The video signal transmission system 1 has a coding device 1A for transmitting data and a decoding d vice 1B for receiving coded data.

After the coding device 1A converts an input video signal VD via a preprocessing circuit 2 into a luminance signal SY and color difference signal SC, these are converted into an 8-bit digital luminance signal DY and color difference signal DC by the analog to digital conversion circuits 3 and 4.

Then, in the coding device 1A the digital luminance signal DY and digital color difference signal DC are written into a luminance signal frame memory 5A and color difference signal frame memory 5B of a frame memory 5, respectively, and thereafter the picture data is transformed from a frame format into a block format in a format conversion circuit 6.

In the coding device 1A the picture data transformed into the block format is input to an encoder 7, and the picture data is high efficiently coded to generate a bit stream which is transmitted to a decoding device 1B via a communication path and a recording media 8.

The encoder 7 is composed of a hybrid coder 7A for discrete cosine transforming the intra frame or inter frame coded (forward, backward, or both way predicted) picture data, and thereafter quantizing the picture data, as well as a variable length coding apparatus 7B for variable length coding and outputting the quantized data.

The decoding device 1B decodes the bit stream taken from the recording media 8 by performing an innersive procedure of the coding device 1A. That is, the decoding device 1B inverse transforms the bit stream high efficiency coded by a decoder 9 so as to restore it, and transforms it from the block format into the frame format in a format transform circuit 10.

Then, in the decoding device 1B the digital luminance signal DY and digital color difference signal DC transformed into the frame format are written into a luminance signal frame memory 11A and a color diff rence signal frame memory 11B, respectively.

Thereafter, in the decoding device 1B, the above signals are converted into analog signal SY and SC via digital to analog conversion circuits 12 and 13, and the decoding device 1B inputs the signal to a post processing circuit 14 to obtain an output picture and output it as an output video signal VO.

The video signal transmission system 1 is constituted so as to transmit or receive data through a series of the processes.

In this connection, the video signal transmission system 1 processes the data of a frame picture in the unit shown in Figs. 4A to 4C. First, the data for a frame picture is divided into N slices as shown in Fig. 4A. Each slice includes M macroblocks as shown in Fig. 4B and each macroblock includes luminance signal data Y1 to Y4 corresponding to 8 x 8 pixels and color difference data Cb and Cr corresponding to the total pixel data as shown in Fig. 4C.

In this case, the picture data stream in each slice is arrang d so that picture data follows in macroblocks, and also follows in microblocks in each macroblock in order of raster scanning.

The macroblock uses picture data (Y1 to Y4) for 16 x 16 pixels following in the horizontal and v rtical scanning directions for a luminance signal as one unit,

but uses on microblock Cr or Cb assigned to the data for 16 x 16 pixels as an unit, because the data quantity is decreased and th reafter time base multiplexed for two color diff rence signals corresponding to the picture data (Y1 to Y4) for 16 x 16 pixels.

For the coding device 1A, only one type of variable length coding (VLC) apparatus 7B of the encoder 7 for high efficiency coding picture data is given as a conversion table (hereinafter referred to as "VLC table") used for variable length coding quantized data independent of the type of picture processed. For the encoder 7 based on MPEG1 (Moving Picture Experts Group 1), for example, the VLC table is constituted in accordance with the quantized data generated through inter frame coding.

However, the result of comparing the quantization data generated by inter frame coding with the quantized data generated by intra frame coding does not always have the same frequency distribution. That is, when considering the quantized data generated by intra frame coding as a macroblock, it is very similar to the quantized data generated by inter frame coding in composition, but a considerably large differnce is found between them in the overall composition (or inclination). Therefore, it is estimated that a high efficiency coding cannot be expected merely by directly applying the VLC table prepared corresponding to inter frame coding to the processing of the quantized data generated through intra frame coding.

According to the invention there is provided a coding method for variable length coding quantized input data in predetermined blocks (e.g. in macroblocks), in which input data is variable length coded by using any one of a plurality of given variable length coding tables 23C and 23D which is selected in accordance with the coding efficiency.

Moreover, this invention uses a coding apparatus for variable length coding quantized input data in predetermined blocks (e.g. in macroblocks), the coding apparatus comprising: a plurality of variable length coding tables 23C and 23D assigned with different sign lengths; a coded information generating means 22 for designating the change of variable length coding tables used for variable length coding input data in accordance with a coding efficiency: and a coding m ans 23A and 23B for variable length coding input data by using any one of the variable length coding tables 23C and 23D, which is selected in accordance with the coded information outputted from the coded information generating means 22.

Furthermore, this invention uses a decoding m thod for variable length decoding coded data inputted by a r cording medium or transmission path in predetermined blocks (e.g. in macroblocks), in which a variable l ngth coding tabl identical to the variabl length coding table 23C or 23D used when cod d data is generated is s l cted among a plurality of given variable length coding tables 32C and 32D and coded data is variable length decoded by using the variabl length coding table 32C or 32D.

Furthermore, this invention uses a decoding apparatus for variable length decoding coded data inputted through a recording medium or transmission path in predetermined blocks (e.g. in macroblocks), the decoding apparatus comprising: a plurality of variable length coding tables 32C and 32D assigned to different sign lengths; a switching means 32B for selecting a variable length coding table identical to the variable length coding table 23C or 23D used when the coded data is generated is selected among a plurality of variable length coding tables 32C and 32D in accordance with coded information extracted from coded data; and decoding means 32A for variable length decoding coded data by using the variable length coding table 32C or 32D selected by the switching means 32B.

It is possible to further improve the variable length coding efficiency compared with the case in specifying one variable length coding table by using the variable length coding table 23C or 23D selected among a plurality of given variable length coding tables 23C and 23D based on a coding efficiency and variable length coding input data. Upon thereby generating information content identical to the content when specifying one variable length coding table, it is possible to process data quantized in a smaller quantization size and further improve the quality of information to be transmitted as coded data.

It is possible further to improve the variable length coding efficiency by variable length coding input data with a variable length coding table selected in accordance with the coding efficiency among a plurality of variable length coding tables prepared compared with the case for performing variable length coding with only one variable length coding table.

Thereby, when generating the information content equal to that generated by using one variable length coding table, it is possible to select a smaller quantized size and further improve the quality of the information transmitted as coded data.

Embodiments of the invention described below provide a coding method and system with a higher coding efficiency than conventional ones, and a decoding method and system for decoding the thus-coded data.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which like parts are designated by like ref r nce numerals or characters throughout, and in which:

Figs. 1A and 1B are schematic diagrams for explaining inter frame coding;

Fig. 2 is a schematic diagram showing a picture structure in a picture sequence;

Fig. 3 is a block diagram showing a video signal

transmission system;

Figs. 4A to 4C are schematic diagrams showing a hierarchical structure of picture data;

Fig. 5 is a block diagram showing a coding system using the variable length coding according to an embodiment of this invention;

Fig. 6 is a flow chart for explaining a variable length coding procedure;

Fig. 7 is a block diagram showing a hybrid coder;

Fig. 8 is a frequency distribution diagram showing the generation frequency of quantized data obtained through intra frame coding;

Fig. 9 is a frequency distribution diagram showing the generation frequency of quantized data obtained by inter frame coding;

Figs. 10A and 10D are schematic diagrams showing a DCT coefficient scanning procedure;

Figs. 11A to 11C are schematic diagrams for explaining quantized data having two-dimensional data of runs and levels;

Fig. 12 is a chart showing a VLC table for inter frame coding;

Fig. 13 is a chart showing assignment of bits in accordance with a VLC table for inter frame coding;

Fig. 14 is a chart showing a VLC table for intra frame coding;

Fig. 15 is a chart showing assignment of bits in accordance with a VLC table for intra frame coding;

Fig. 16 is a block diagram showing a decoding system using variable length decoding according to an embodiment of this invention;

Fig. 17 is a block diagram showing a hybrid decoder;

Fig. 18 is a block diagram showing a coding system using variable length coding according to an embodiment of this invention;

Fig. 19 is a block diagram showing a table change signal generator;

Fig. 20 is a flow chart for explaining a variable length coding procedure; and

Fig. 21 is a block diagram showing a decoding apparatus using variable length coding according to an embodiment of this invention.

Preferred embodiments of this invention will be described with reference to the accompanying drawings:

(1) First embodiment

(1-1) Constitution of encoder

In Fig. 5, 20 repres nts an encoder constituting a motion pictur coding apparatus as a whole, which is charact rized by using two types of variable length coding tables corr sponding to the coding system to improve a coding efficiency. A frame memory 21 fetches input picture signals S0 in order and supplies picture data S1 to be processed at present in macroblocks to a hybrid coder 22.

The hybrid coder 22 movement compensation predicted codes the picture data S1 and thereafter hybrid codes the picture data S1 by discrete cosine transform (DCT).

The hybrid coder 22 supplies picture information to a variable length coding (VLC) section 23 as a quantized signal S2 and control information to it as a picture coding control signal S3 among processed results obtained by hybrid coding.

The VLC section 23 inputs the quantized signal S2 to a VLC circuit 23A and the picture coding control signal S3 to a VLC circuit 23A and a table changer 23B. In this connection, the quantized signal S2 has a DCT coefficient which is a movement compensation predicted error signal in a macroblock layer and run length information and the picture coding control signal S3 has control information including movement vector, macroblock type (presence or absence of movement compensation mode and DCT coefficient), and DCT mode.

The VLC circuit 23A variable length codes the DCT coefficient inputted as the quantized signal S2 based on two conversion tables (that is, the VLC table 23C for intra frame coding and the VLC table 23D for inter frame coding).

The movement compensation mode signal inputted as the picture coding control signal S3 is used to exchange the two conversion tables in the VLC circuit 23A. Exchanging the two conversion tables is described below by referring to Fig. 6.

First, the VLC circuit 23A starts with a processing routine RT0. When the VLC circuit 23A inputs the DCT coefficient and run length information from th hybrid coder 22 in the step SP1, it judges if the picture data to be processed is an intra frame coding mode or not in the next step SP2.

If so, the VLC circuit 23A proceeds to the step SP3 and references the VLC table 23C for intra frame coding to obtain corresponding variable length coded data. If not, the VLC circuit 23B proceeds to the step SP4 and references the VLC table 23D for inter frame coding to obtain corresponding variable length coded data.

Then, the VLC circuit 23A transfers the variabl length coded data obtained by reference to each table to a buffer memory 24 for transmission (step SP5) and then terminates all processing (step SP6).

Thereby, the VLC circuit 23 variable length codes quantized data together with a quantizing step size and macroblock (movement compensation mode) and supplies it to the transmission buffer memory 24 as transmission data.

The buffer memory 24 stores the data thus variable length coded and thereafter outputs the data as a bit stream at a certain transmission rate.

In this case, the buffer memory 24 returns quantization control signals in macroblocks to a quantization circuit bas d on the data quantity remaining in the memory so as to control the quantizing step size. The buffer memory 24 thereby adjusts the data quantity generated as a bit stream to keep the data in the memory at a proper quantity (a data quantity causing no overflow or underflow).

That is, when the quantity of remaining data increases up to the allowable upper limit, the buffer memory 24 decreases the quantity of quantized data by increasing the quantizing step size of the quantization circuit with the quantization control signal. However, when the quantity of remaining data decreases down to the allowable lower limit, the buffer memory 24 increases the quantity of quantized data by decreasing the quantizing step size of the quantization circuit with the quantization control signal.

(1-2) Constitution of hybrid coder

Signal processing of the hybrid coder 22 is described below by referring to Fig. 7.

The hybrid coder 22 supplies a block format picture to a motion vector detection circuit 22A through the frame memory 21 to detect a motion vector.

The motion vector detection circuit 22A, as already described in Fig. 2, generates an interpolation picture by using a noninterpolation frame (that is, intra frame predicted frame) as a predicted picture and using the detected motion vector.

In this case, the motion vector detection circuit 22A processes the picture data for each frame as an intra picture, predicted picture, or bidirectional picture based on previously set predetermined sequences.

The frame memory 21 stores the picture data for each frame in a front original picture memory section 21A, reference original picture memory section 21B, or rear original picture memory section 21C in accordance to these predetermined sequences.

The motion vector detection circuit 22A reads a reference picture DATA and predicted picture DATA (that is, front original picture and rear original picture) from the original picture memory sections 21A to 21C to detect the motion vector for each block. At this time, the motion vector detection circuit 22A uses the minimum value among the absolute value sums of inter frame differences.

The motion vector detection circuit 22A transmits the absolute value sums of inter frame differences obtained in blocks to an intra frame/forward/bidirectional predicted judgment circuit 22B.

The intra frame/forward/bidirectional predicted judgment circuit 22B det rmines the frame type of a reference block along with the absolute value sums and exchanges the processes of an operation section 22C in macroblocks in along with the determined frame type.

In the case of an intra frame coded frame, the operation section 22C outputs a picture inputted from the motion vector detection circuit 22A through a switching circuit 22C3.

For a forward predicted coded frame or bidirectional predicted coded frame, a subtracter 22C1 or 22C2 generates intra frame coded data from a predicted picture and outputs the differential data through the switching circuit 22C3.

After a discrete cosine transform (DCT) circuit 22D inputs intra frame coded or inter frame coded picture data from a computing unit 22C, it discrete cosine transforms the input picture data or differential data in blocks by using two dimensional correlation of video signals.

A quantizer 22E quantizes the DCT coefficient obtained by transforming a macroblock and a quantizing step size determined for each slice and outputs the quantized data obtained through the quantization at an output terminal to a variable length coding section 23.

In this connection, the quantizing step size of the quantizer 22E is determined to a value so as not to exceed the capacity of a transmission by returning the remaining capacity of the transmission buffer. The quantizing step size is also outputted to the variable length coding circuit 23.

The hybrid coder 22 inputs the quantized data and quantizing step size to be outputted to the variable length coding section 23 to an inverse quantizer 22F to start local decoding.

The inverse quantizer 22E decodes the data to be transformed in the quantizer 22E by inversely quantizing the quantized data sent from the quantizer 22E into a representative value and transforming it into inversely quantized data and supplies the inversely quantized data to an inverse discrete cosine transform (IDCT) circuit 22G.

The IDCT circuit 22G transforms the inversely quantized data decoded by the inverse quantization circuit 22F into decoded picture data by a transform processing inverse to that of the DCT circuit 22D and inputs it to a computing unit 22H.

Data same as the predicted picture data supplied to the computing unit 22C is supplied to the computing unit 22H so as to add the predicted picture data outputted by a motion compensation circuit 22J to the differential data outputted by the IDCT circuit 22G.

Thereby, picture data for the original (restored) predicted picture and picture data for the original (restored) intra picture are obtained and stored in a rear original picture memory section 22I1 and a front original picture memory section 22I2 of a frame memory 22I respectively.

After the picture data is stored in the rear original picture memory section 22I1 and front original picture memory section 22I2 respectively, the motion vector detection circuit 22A starts the next picture process-

ing.

The motion compensation circuit 22J generates predicted picture data by using the picture data stored in the original picture memory sections 22I1 and 22I2 in accordance with the frame type determined by the intra frame/forward/bidirectional predicted judgment circuit 22B.

That is, for the backward predicted frame, the motion compensation circuit 22J sends a read address deviated by a value corresponding to a motion vector from a position corresponding to the position of a block to be inputted to the operating unit 22C to the rear original picture memory section 22I1 and generates predicted picture data.

For the bidirectional predicted frame, however, the motion compensation circuit 22J sends a read address deviated by a value corresponding to a motion vector from a position corresponding to the position of a block to be inputted to the operating unit 22C to the rear original picture memory sections 22I1 and 22I2 and generates predicted picture data.

(1-3) Variable length coding table

The following is the description of two types of coding tables prepared to efficiently code the quantized data S2 to be inputted from the hybrid coder 22 to the VLC apparatus 23.

The VLC apparatus 23 earns the coding efficiency in varying the sign length of quantized data coded in accordance with a combination of 0-run length (run length) with a quantized data level depending on a generation frequency. For this example, the VLC table 23C for intra frame coding and VLC table 23D for inter frame coding are prepared.

This is because intra frame coded quantized data and inter frame coded quantized data are different from each other in the frequency distributions of a run length and level.

That is, the intra frame coded quantized data is concentrated on a low frequency component because intra frame coding discrete cosine transforms a pattern itself. Therefore, a run length tends to comparatively decreases and a level tends to comparatively rises as shown in Fig. 8.

For the inter frame coded quantized data is scattered up to a high frequency component because a difference with the pattern of other frame is discrete cosine transformed as shown in Fig. 9. Therefore, a run length tends to comparatively increases and a l vel tends to comparatively lower.

The VLC table 23C for intra frame coding and VLC table 23D for inter frame coding are th coding tables assigned with signs so that the sign length of quantiz d data can be effici ntly decreased by reflecting the above composition.

The quantized data S2 to be variable length coded here is obtained by quantizing a DCT coefficient transformed by the scan procedure shown in Figs. 10A to 10D no matter when the data is coded by any coding method.

In general, the quantized data S2 is formed in accordance with a combination of 0-run length with a quantized data level (that is, run and level) as shown in Figs. 11A to 11C. However, when the entire quantized data remaining without being scanned is 0, it is notified to the quantized data S2 by sending end of block (EOB) code that there is no level other than 0 up to finally coded quantized data.

Figs. 12 and 13 show the VLC table 23D for inter frame coding prepared for the quantized data S2 expressed by the format and Figs. 14 and 15 show the VLC table 23C for intra frame coding. In Figs. 12 and 14, the central column shows run length values and the right column shows level values. And, codes assigned to combinations of run lengths with levels are shown in the left column.

From Fig. 12, it is found that in case of the VLC table 23D for inter frame coding a sign with a small bit length is assigned to quantized data with a relatively high generation frequency and a large run length. This is also found from Fig. 13 showing the relationship between actually assigned sign length and combination of a run length with a level.

In other words, this is also found from the fact that a sign with the length of 9 bits is assigned to the quantized data with the run length of "0" and the level of "5" but only a sign with the length of 6 bits is assigned to the quantized data with the run length of "4" and the level of "1".

In this connection, the bit length shown in Fig. 13 is a value obtained by adding one bit to the code length of the VLC table 23D for inter frame coding shown in Fig. 12.

The VLC table 23D for inter frame coding assigns a code with the sign length of 20 bits to quantized data of a combination with a relatively low generation frequency instead of assigning a sign so as to fixed length code the quantized data. In this case, six bits of the above 20 bits are assigned to "ESCAPE code", six bits of them are assigned to "run length", and eight bits of them are assigned to "level".

From Fig. 14, it is found that in case of the VLC table 23C for intra frame coding a sign with a small bit length is assigned to quantized data with a relatively high generation frequency and a low level. This is also found from Fig. 15 showing the relationship betw en each combination and a sign length actually assigned to each combination.

In other words, this is also found from the fact that a sign with the length of 6 bits is assigned to quantized data with the run length of "0" and the level of "5" but only a sign with the length of 7 bits is assigned to quantized data with the run length of "4" and the level of "1".

Also in the case of Fig. 15, the bit length assigned

for a combination of a run length with a level is a value obtained by adding n bit to the code length of the VLC table 23C for intra frame coding shown in Fig. 14.

The VLC table 23C for intra frame coding assigns a code with the sign length of 22 bits to quantized data of a combination with a relatively low generation frequency instead of assigning a sign so as to fixed length code the quantized data. In this case, eight bits of the above 22 bits are assigned to "ESCAPE code", six bits of them are assigned to "run length", and eight bits of them are assigned to "level".

(1-4) Constitution of decoder

The following is the description of the constitution of a decoder for restoring a motion picture from a bit stream coded by the encoder 20 and transmitted through a transmission path or media.

In Fig. 16, 30 represents a decoder constituting a motion picture decoding device as a whole. The decoder 30 temporarily stores a bit stream S10 inputted from media or the like in a receiving buffer memory 31 and successively inputs it to an inverse variable length coding (inverse VLC) section 32 at a predetermined timing.

The inverse VLC section 32 inverse VLC codes the information related to movement compensation of header information included in a bit stream S11 with an inverse VLC circuit 32A and thereafter supplies restored results to a table changer 32B as a motion compensation mode signal S13.

In this case, the table changer 32B selects the VLC table 32C for intra frame coding as an inverse transform table when the motion compensation mode of a macroblock to be processed is a intra frame coding mode but selects the VLC table 32D for inter frame coding as an inverse transform table when the motion compensation mode is an inter frame coding mode.

The inverse VLC circuit 32A refers to the inverse coding table thus selected by the table changer 32B to inverse VLC code a DCT coefficient and run length inputted as the bit stream S11.

The hybrid decoder 33 inputs from inverse VLC circuit 32A the DCT coefficient and run length information of the motion compensation predict error signal obtained for the macroblock layer and decoded data S12 of the motion vector and motion compensation mode, etc.

A hybrid decoder 33 restores picture data by dec ding high efficiently coded data according to a proc dure reverse to that of the hybrid coder 22.

(1-5) Constitution of hybrid d coder

The internal structure of the hybrid decoder 33 is d scribed below by r ferring to Fig. 17.

The hybrid decoder 33 sends a quantiz d st p and picture data of the variable length coded data inputted from the inverse VLC section 32 to an inverse quantizer 33A and also sends a motion vector, predicted mode, predicted flag, and DCT flag to a motion compensation circuit 33D.

The inverse quantizer 33A inversely quantizes the picture data supplied from the inverse VLC apparatus 32 in accordance with the quantized step similarly supplied from the inverse VLC section 32 and supplies the data to an invert discrete cosine transform (IDCT) circuit 33B.

The IDCT circuit 33B inverse DCT transforms a DCT coefficient inputted from the inverse quantizer 33A to supply it to an operating unit 33C.

The operating unit 33C restores an original picture by adding the output of the IDCT circuit 33B to the data motion compensated by the motion compensation circuit 33D.

The picture data thus outputted from the computing unit 33C is outputted to an output terminal and also it is stored in a frame memory 33E.

The frame memory 33E is provided with a front predicted picture memory section 33E1 and a rear predicted picture memory section 33E2. The front predicted picture memory section 33E1 stores a predicted picture and an intra picture for generating a bidirectional picture and the rear predicted picture memory section 33E2 stores a predicted picture for generating a predict picture or bidirectional picture.

The motion compensation circuit 33D compensates the motion of picture data stored in the front predicted picture section 33E1 and rear predicted picture section 33E2 and sends the data to the computing unit 33C in accordance with a mode of the picture data to be decoded.

(1-6) Coding and decoding

The following is the description of coding by a motion picture coding section for successively coding motion pictures in accordance with a predetermined procedure with the above constitution.

The motion picture coding section stores a motion picture converted into digital data by a pre-processing circuit 2 or the like in the encoder 20 through a frame memory 21 to high efficiently code the data with the encoder 20.

The encoder 20 hybrid codes the picture data read from the frame memory 21 with the hybrid coder 22 and sends the quantized data which is motion compensated and DCT transformed and thereafter quantized to the VLC section 23.

The VLC section 23 variable length codes a coding table used for variable length coding by changing the VLC table 23C for intra frame coding and the VLC table 23D for inter frame coding correspondingly to two typ s of coding modes.

Thus, the VLC section 23 variable length codes a transmission picture by using the VLC table 23C for

intra frame coding for reflecting the genernerneration frequency of intra frame coded quantized data when the picture comprises intra frame coded picture data but variable length codes the picture by using the VLC table 23D for inter frame coding for reflecting the generation frequency of inter frame coded quantized data when the picture is composed of inter frame coded picture data.

The above configuration makes it possible to further decrease the bit length of transformed and thereafter outputted picture data even though it is the quantized data coded by any coding system, compared with the existing case in which variable length coding is performed by using a VLC table for inter frame coding.

Thereby, it is possible to decrease the transmission rate for transmitting the same motion picture compared with the existing one and decrease the quantized size by a value equivalent to the decrease of the transmission rate. Thus, for the coding system of this embodiment, it is possible to increase information content to be assigned to each pixel by a value equivalent to the decrease of the quantized size and further improve the picture quality compared with the existing one.

Moreover, because it is possible to use an existing coding table for the VLC table 23D for inter frame coding of this embodiment, the compatibility with existing models is also compensated.

In this connection, because the information about whether to perform intra frame or inter frame coding every macroblock is sent together with picture data even for an existing coding system, it is not necessary to newly add the information about which VLC table should be used to header information.

(2) Second Embodiment

(2-1) Constitution of Encoder

In Fig. 18 in which a portion corresponding to that in Fig. 5 is provided with the same symbol, symbol 40 represents an encoder constituting a motion picture coding system as a whole which has the same constitution as the encoder in Fig. 5 except a table change signal generator 41 for selecting a coding table requiring a small bit length regardless of a predicted coding system (frame type) by considering the information content generated by using each coding table in addition to the fact that two types of transform tables corresponding to a coding system are prepared as variable length coding tables.

Th table change signal generator 41 has the constitution shown in Fig. 19.

The table change signal generator 41 has two generated information counting sections to calculate the information content generated by using each transform table before starting variable length coding with the VLC apparatus 23.

The table change signal generator 41 inputs a DCT coefficient and run length information to two VLC circuits 41A and 418 from the hybrid coder 22 to variable length code quantized data with the VLC circuits 41A and 41B.

In this case, the VLC circuit 41A uses the VLC table 23C for intra frame coding as a coding table and the VLC circuit 41B uses the VLC table 23D for inter frame coding as a transform table.

The data variable length coded by the VLC circuit 41A and the data variable length coded by the VLC circuit 41B are sent to the number of bits counters 41C and 41D respectively where the number of bits representing the generated information content is counted. In this case, the number of bits counters 41C and 41D update the generated information content stored in memories 41C2 and 41D2 by sequentially adding the number of bits of newly coded variable length data to the number of bits stored in the memories 41C2 and 41D2 with adders 41C1 and 41D1.

A comparator 41E sends a data request signal SR to the memories 41C2 and 41D2 in order to compare the information content generated in macroblocks and compares the number of bits stored in the memory 41C2 with that stored in the memory 41D2 at the timing when a response signal SA representing that the number of bits of all macroblocks is request d from the memories 41C2 and 41D2 is inputted.

The comparator 41E outputs the comparison result to the VLC circuit 23A and table changer 23B of the VLC apparatus 23 as a table change signal. Thereby, the comparator 41E shows the VLC circuit 23A a coding table with which variable length coding should be performed and changes the connection of the table changer 23B.

A series of these processing by an encoder 40 is described by referring to Fig. 20.

The encoder 40 starts the processing of a processing routine RT1 when the processing by the hybrid coder 22 terminates and quantized data is obtained and then starts the processing in the steps SP10 and SP11. In the steps SP10 and SP11, the table chang signal generator 41 counts the generated number of bits N1 when variable length coding quantized data by using the VLC table 23C for intra frame coding and the generated number of bits N2 when variable length coding quantized data by using the VLC table 23D for inter frame coding in order.

When counting of the generated number of bits N1 and the generated number of bits N2 for each macroblock terminat s, the tabl change signal generator 41 starts the next step SP12 to store the number of bits in a memory and determine a counted value.

The table change signal generator 41 decides a coding table for coding with which the generated number of bits is minimized in the next step SP13 (ac-

tually, comparison is performed by the comparator 41E).

When the table change signal generator 41 decides that the generated number of bits is minimized by the VLC table 23C for intra frame coding, it starts the step SP14 to control the table changer 23B so as to refer to the VLC table 23C for intra frame coding according to a change signal.

However, when the table change signal generator 41 decides that the generated number of bits is minimized by the VLC table 23D for inter frame coding, it starts the step SP15 to control the table changer 23B so as to refer to the VLC table 23D for inter frame coding according to a change signal.

When these changes terminate, the step SP16 is started and the VLC circuit 23A starts variable length coding the quantized data having a DCT coefficient and a run length fetched from the hybrid coder 22.

Moreover, the VLC circuit 23A adds a flag for designating the coding table used for variable length coding in the step SP17 to header information as control data.

In the step SP18, the VLC circuit 23A transfers variable length coded picture data to a buffer memory 24 for transmission together with the header information to temporarily store them and then writes the stored data in a transmission path or media from the buffer memory 24 to terminate the above coding.

(2-2) Constitution of Decoder

The constitution of a decoder for decoding picture data high efficiently coded by the encoder 40 is described below by referring to Fig. 21. In Fig. 21 in which a portion corresponding to that in Fig. 16 is provided with the same symbol, symbol 50 represents a decoder which has the same constitution as that in Fig. 16 except that an inverse VLC circuit 51 is used instead of the inverse VLC circuit 32A of the inverse VLC section 32.

The inverse VLC circuit 51 inversely VLC codes header information to extract a flag showing the coding table selected in variable length coding among the transform results and use it to change the table changer 32B.

As the result of the above change, the inverse VLC circuit 51 refers to the transform table selected by the table changer 32B to inversely VLC transform a DCT coefficient and run length information inputted as bit streams.

(2-3) Coding and Decoding

The following is th description of coding performed by a motion picture coding system for successively coding motion pictures according to a predetermined procedure with the above constitution.

The motion picture coding system stores a motion picture converted into digital data by the pre-processing circuit 2 or the like in the encoder 40 through the frame memory 21 to high efficiently code the data with the encod r 40.

The encoder 40 hybrid codes the picture data read from the frame memory 21 with the hybrid coder 22 and sends the quantized data which is motion compensated and DCT transformed and thereafter quantized to the VLC apparatus 23.

In this case, the quantized data same as that sent to the VLC apparatus 23 is also inputted to the table change signal generator 41 to decide a coding table form minimizing the generated information content for variable length coding.

This is because intra frame coded quantized data of a macroblock includes data with a composition very close to inter frame coded quantized data of the macroblock and data with a composition not very close to it and therefore intra frame coded quantized data cannot be always transformed into smaller number of bits by using a VLC table for intra frame coding.

Therefore, intra frame coded quantized data of a macroblock with a composition very close to inter frame coded quantized data of the macroblock is variable length coded by using the VLC table 23D for inter frame coding and macroblocks other than the above macroblock are variable length coded by using the VLC table 23C for intra frame coding. Thereby, it is possible to further improve the coding efficiency for variable length coding.

In this case, because a coding table used for variable length coding does not depend on an intra frame coding system or inter frame coding system in general, it is necessary to code and transmit the information showing which VLC table is used for variable length coding together with variable length coded data.

Therefore, a VLC table formed by adding one bit to each macroblock is used.

The above constitution makes it possible to realize a variable length coding system with higher variable length coding efficiency than the existing one by variable length coding data with a composition close to quantized data generated through inter frame coding by using a VLC table for inter frame coding even when variable length coding quantized data generated through intra frame coding and selecting either of two coding tables for further decreasing generated information content for each block.

Therefore, it is possible to decrease the transmission rate for transmitting the same motion picture compared with the existing one and decrease the quantizing st p size by a value equivalent to the d creas of th coding rate. Thus, the coding system of this mbodiment makes it possible to increase the information content to be assigned to each pixel compared with an existing coding system which has only one VLC tabl and further improve the picture quality.

Moreover, though this variable length coding system requires additional information of one bit for each macroblock, generated information content can be decreased because it is possible to make the decrease rate of the number of bits larger than the increase rate of the number of bits for additional information by properly changing VLC tables.

(3) Other Embodiments

In the above embodiment, a video signal transmission system used for a video conference system and visual telephone system is described. However, this invention is not restricted to the system but it can be widely applied to a system using various types of recording and reproducing systems and a system using transmitting and receiving systems.

Moreover, in the above embodiment, a case is described in which the quantized data obtained from picture data is variable length coded. However, this invention is not restricted to the case but it can be widely applied to cases for variable length coding the quantized data obtained from other data such as voice data.

Furthermore, in the above embodiment, a case is described in which two variable length coding tables are prepared correspondingly to data which is intra framed coded and thereafter quantized and data which is inter frame coded and thereafter quantized. However, this invention is not restricted to the case but it can be applied to a case in which three or more variable length coding tables assigned with different sign lengths are prepared.

Furthermore, in the above embodiment, a case is described in which intra frame coded or inter frame coded picture data is discrete cosine transformed. However, this invention is not restricted to the case but it can be widely applied to cases for transforming the data with any other orthogonal coding system.

Furthermore, in the above embodiment, a case is described in which quantized data is variable length coded in macroblocks.

However, this invention is not restricted to the case but it can be widely applied to cases for using a block with any size as the processing unit.

Claims

1. A coding method for variable length coding quantized input data in predetermined blocks, comprising the step of:

   variable l ngth coding the input data by using a variable length coding table selected among a plurality of variable length coding tables (23C, 23D) prepared based on coding fficiency.

2. A coding system for variable length coding quantized input data in predetermined blocks, comprising:

   a plurality of variable length coding tables (23C, 23D) assigned with different sign lengths;

   a coded information generating means (22) for designating change in variable length coding tables used for variable length coding the input data based on with coding efficiency; and

   coding means (23A, 23B) for variable length coding the input data by using a variable length coding table (23C, 23D) selected by coded information outputted from the coded information generating means.

3. A decoding method for decoding coded data inputted through a recording medium or transmission path in predetermined blocks, comprising the step of:

   selecting a variable length coding table identical to the variable length coding (23C, 23D) used when the coded data is generated among a plurality of variable length coding tables (32C, 32D) prepared and variable length decoding the encoded data by using the variable length coding table (32C, 32D).

4. A decoding system for variable length decoding coded data inputted through a recording medium or transmission path in predetermined blocks, comprising:

   a switching means (32B) for selecting a variable length coding table (32C, 32D) identical to variable length coding (23C, 23D) used when the coded data is generated in accordance with coded information extracted from the coded data among the variable length coding tables (32C, 32D); and

   a decoding means (32A) for variable length decoding the coded data by using a variable length coding table (32C, 32D) selected by the switching means (32B).

5. A coding system according to claim 2, wherein input data is data motion compensated and thereafter quantized, and the coded information is information generated based on a predictive coding system.

6. A decoding system according to claim 4, wherein;

   input data is data movement compensated and thereafter quantized, and the coded information is information generated based on a predictive coding system.

7. A coding method according to claim 1, wherein: a variable length coding table is selected based on information content generated when variable length coding the input data by using each of the

prepared variable length coding tables without depending on a variable length coding table corresponding to a predictive coding system.

8. A coding system according to claim 2, wherein:
the coded information generating means designates a variable length coding table for variable length coding the input data based on the information content generated when variable length coding the input data by using each of the prepared variable length coding tables without depending on a variable length coding system corresponding to a predictive coding system.

9. A coding method according to claim 1, wherein:
each piece of information content generated when variable length coding the input data by using each of the variable length coding tables before variable length coding the input data is obtained to select a variable length coding table for variable length coding the input data based on the result of comparing the generated pieces of information content.

10. A coding system according to claim 2, wherein:
the coded information generating means obtains each piece of information content generated when performing variable length coding by using each of the variable length coding tables before the coding means variable length codes the input data and designates a variable length coding table for variable length coding the input data based on the result of comparing the generated pieces of information content.

11. A decoding method according to claim 3, wherein:
a variable length coding table selected based on the generated information content is selected among the prepared variable length coding tables without depending on a variable length coding table corresponding to a predictive coding system to variable length decode the coded data by using the variable length coding table.

12. A decoding system according to claim 4, wherein:
the switching means selects a variable length coding table for variable length coding the input data based on information content generated when variable length coding the input data by using each of the variable length coding prepared tables without depending on a variable length coding system corresponding to a predictive coding system.

13. A coding m thod according to claim 3, wh r in:
a variable length coding tabl identical to the variable l ngth coding table selected for coding is selected among the prepared variable length coding tables before variable length coding the input data to variable length decode the coded data by using the variable length coding table.

14. A decoding system according to claim 4, wherein:
the switching means selects a variable length coding table identical to the variable length coding table selected for coding among the prepared variable length coding tables before the decoding means variable length decodes the input data and variable length decodes the coded data by using the variable length coding table.

15. A coding system for variable length coding quantized data obtainable by the orthogonal transformation of picture data predictively coded for each macroblock, and thereafter quantizing the picture data, comprising:
a first variable length coding table suitable for the generation frequency of data quantized after intra frame coding;
a second variable length coding table suitable for the generation frequency of data quantized after inter frame coding;
a coded information generating means for designating change in the first and second variable length coding tables based on the fact that the quantized data is data intra frame coded or inter frame coded as predictive coding; and
a means for variable length coding the quantized data by using a first or second variable length coding table selected by coded information outputted from the coded information generating means.

16. A decoding system for variable length decoding coded data inputted through a recording medium or transmission path in macroblocks, comprising:
a first variable length coding table suitable for the generation frequency of data quantized after intra frame coding;
a second variable length coding table suitable for the generation frequency of data quantized after inter frame coding;
a changing means for extracting a coding method selected for predictive coding from among coded data to select the first variable length coding table when the coded data is data intra frame coded and thereafter variable length coded, and the s cond variable length coding table when the cod d data is data inter frame coded and ther after variabl length coded; and
a decoding means for variabl length decoding the coded data by using the first or second variable length coding table selected by the switching means.

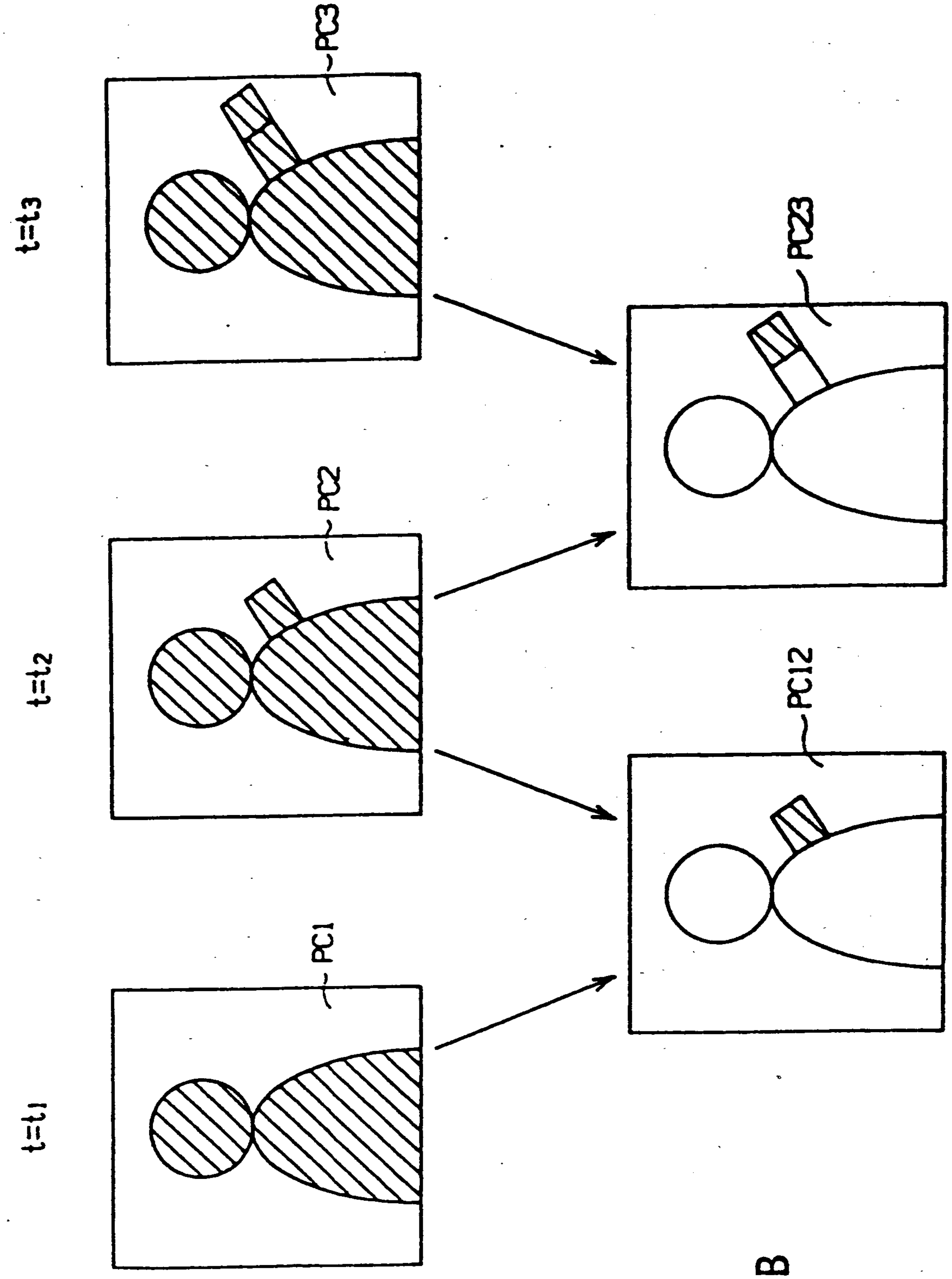


FIG. 1A

FIG. 1B

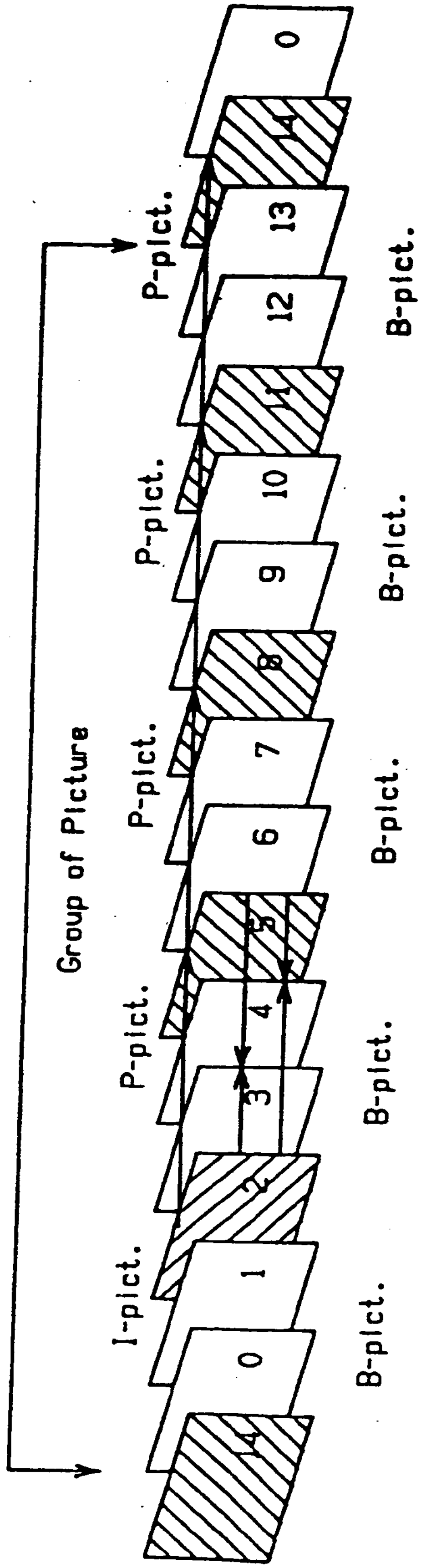
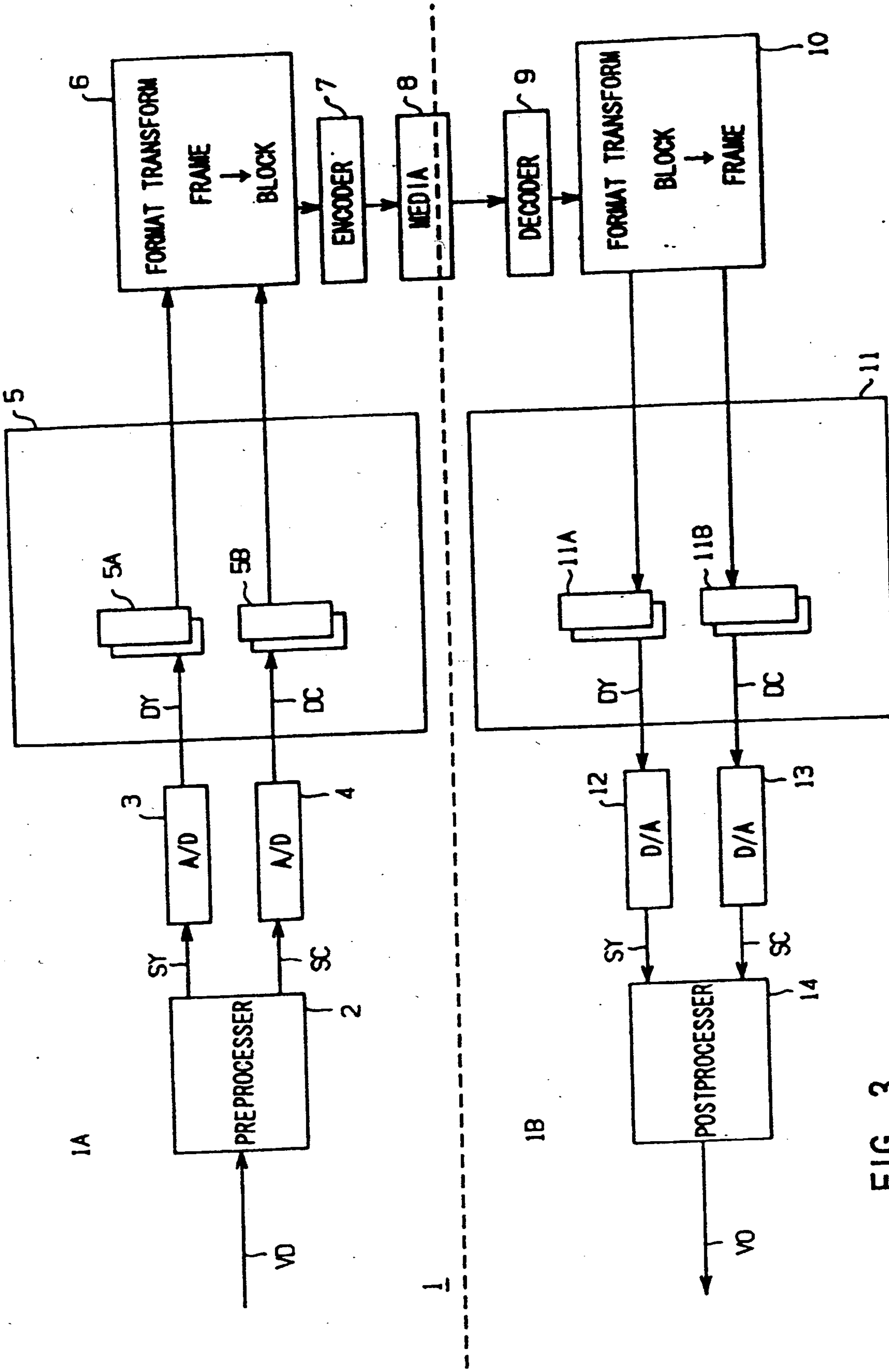

Group of Picture
I-pict.
P-pict.
P-pict.
P-pict.
P-pict.
B-pict.
B-pict.
B-pict.
B-pict.
B-pict.
B-pict.
14
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0

FIG. 2



1A
1B
1
VD
PREPROCESSER
2
SY
SC
A/D
3
A/D
4
5
DY
DC
5A
5B
FORMAT TRANSFORM
FRAME → BLOCK
6
ENCODER
7
MEDIA
8
DECODER
9
FORMAT TRANSFORM
BLOCK → FRAME
10
11
11A
11B
DY
DC
D/A
12
D/A
13
SY
SC
POSTPROCESSER
14
VO

FIG. 3

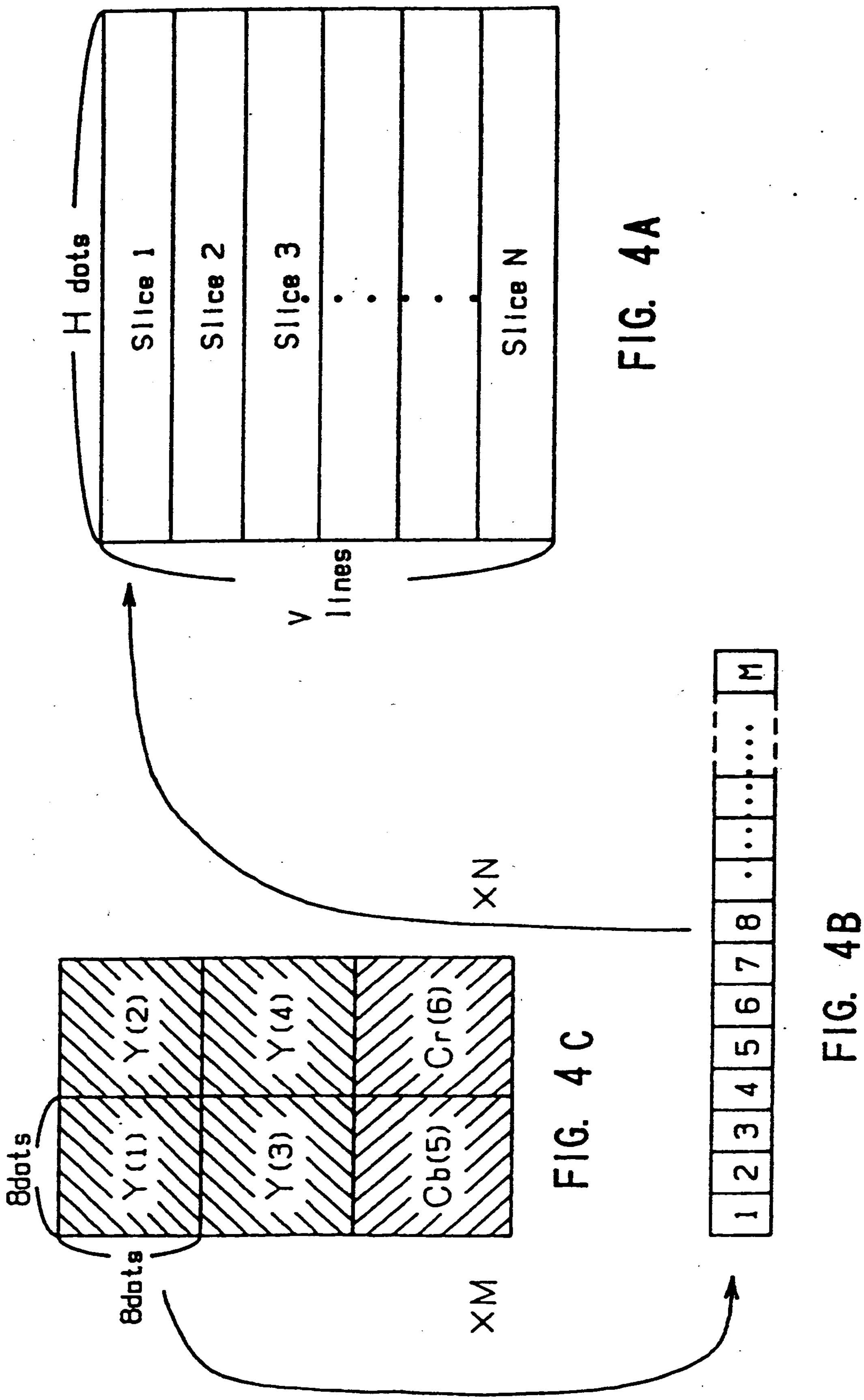


FIG. 4A

FIG. 4B

FIG. 4C

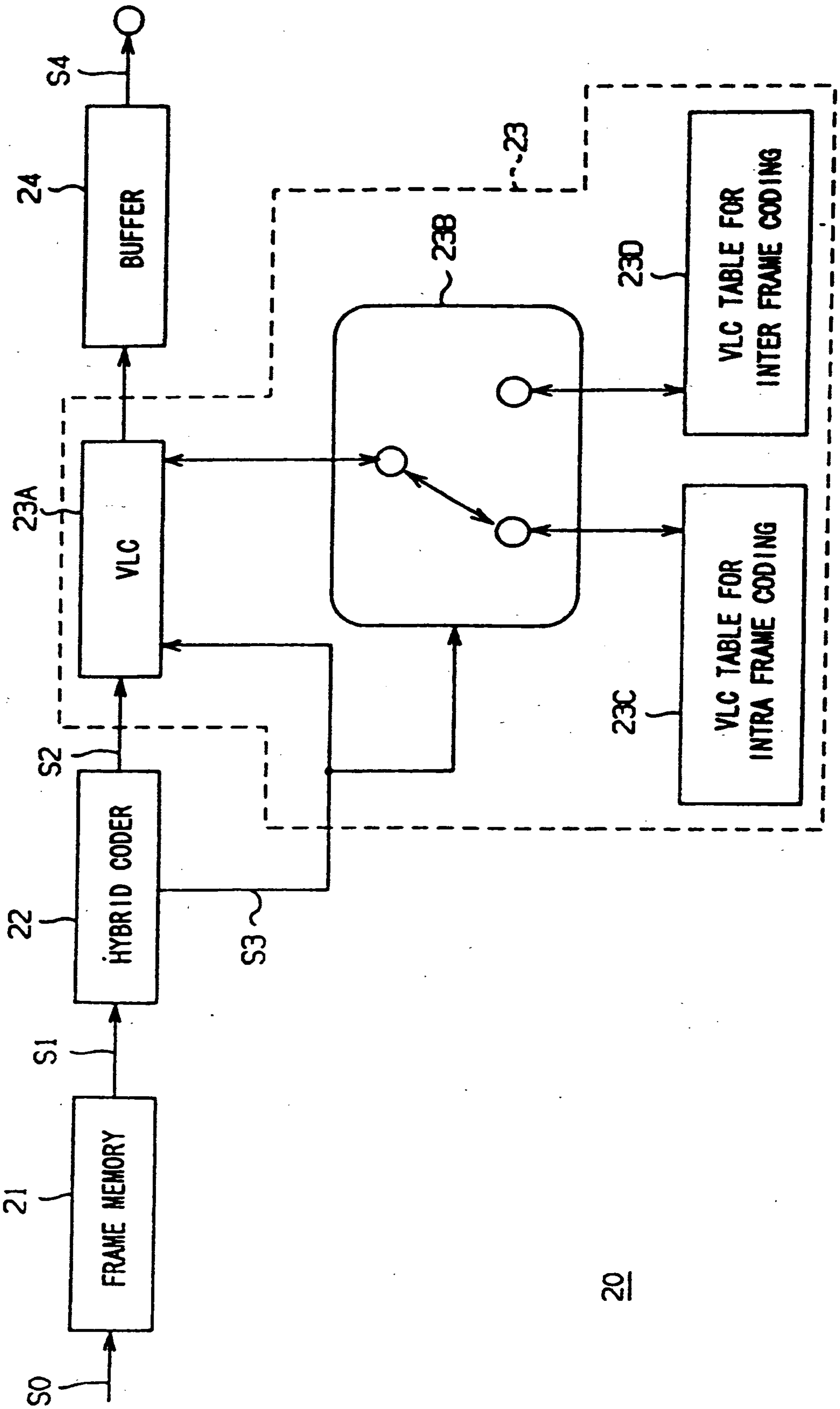

S0
FRAME MEMORY
21
S1
HYBRID CODER
22
S2
S3
VLC
23A
BUFFER
24
S4
23
23B
VLC TABLE FOR INTER FRAME CODING
23D
VLC TABLE FOR INTRA FRAME CODING
23C
20

FIG. 5

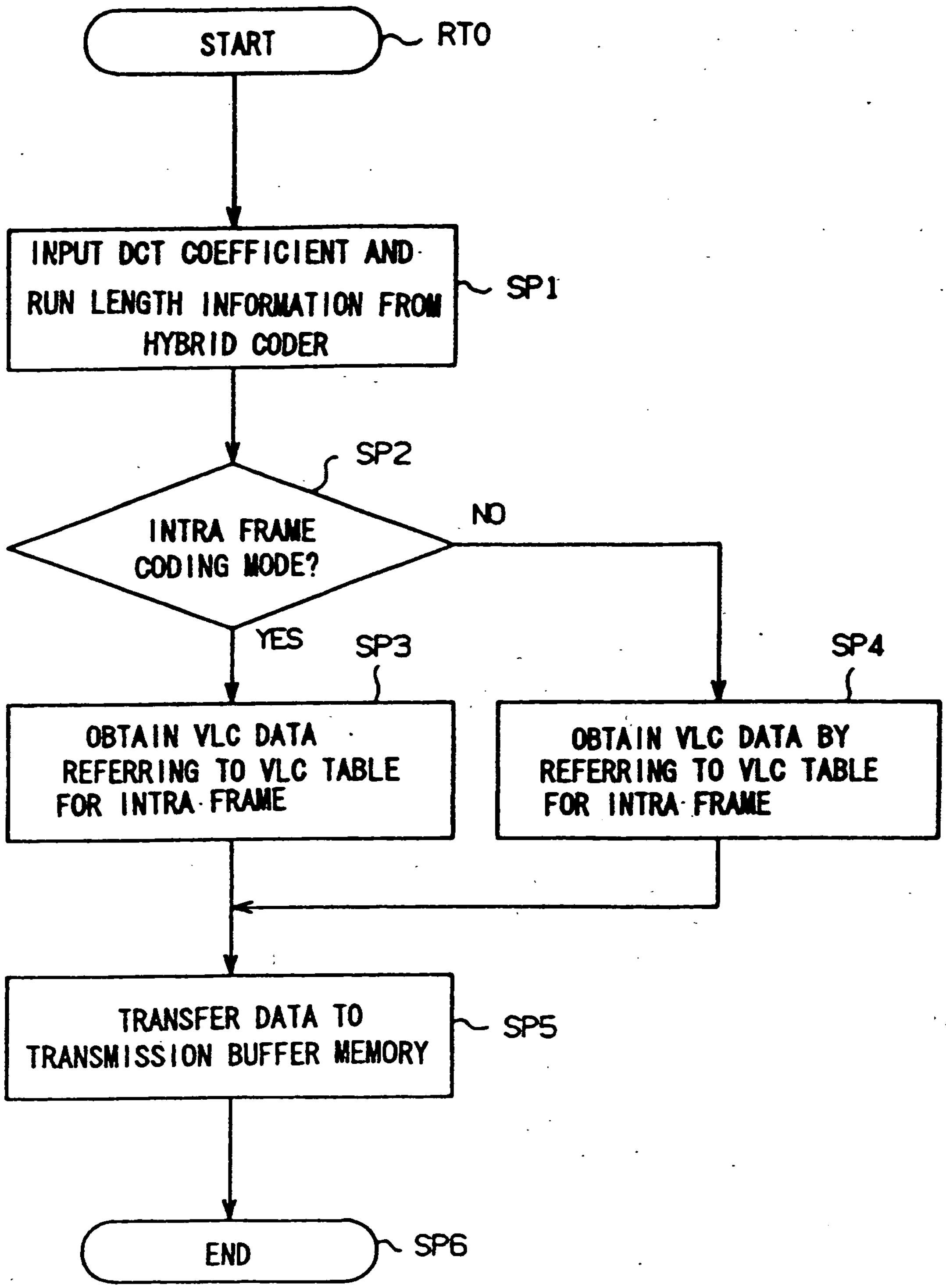

START
RT0
INPUT DCT COEFFICIENT AND RUN LENGTH INFORMATION FROM HYBRID CODER
SP1
SP2
INTRA FRAME CODING MODE?
NO
YES
SP3
SP4
OBTAIN VLC DATA REFERRING TO VLC TABLE FOR INTRA FRAME
OBTAIN VLC DATA BY REFERRING TO VLC TABLE FOR INTRA FRAME
TRANSFER DATA TO TRANSMISSION BUFFER MEMORY
SP5
END
SP6

FIG. 6

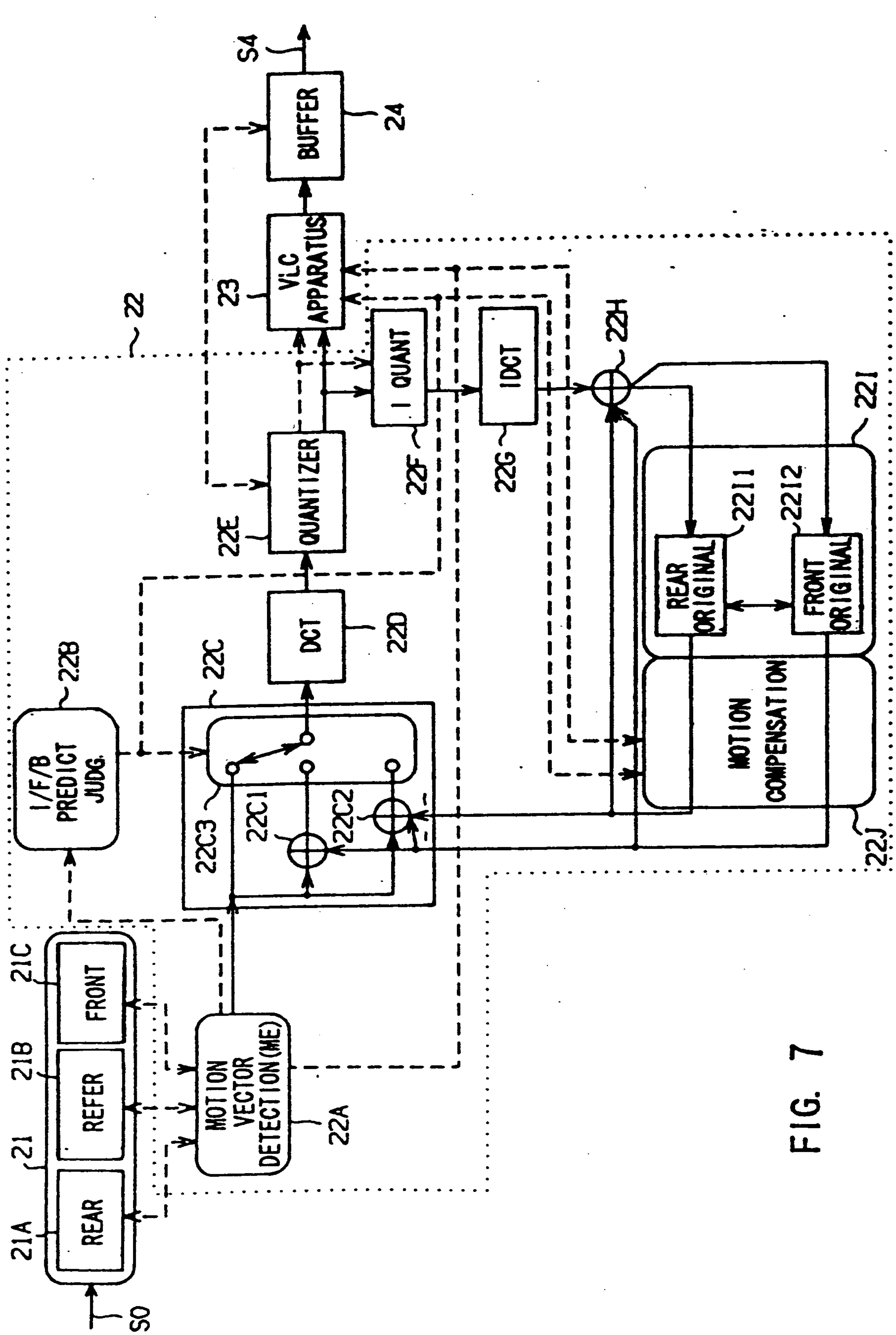

S0
21A
REAR
21
21B
REFER
21C
FRONT
MOTION VECTOR DETECTION (ME)
22A
22
I/F/B PREDICT JUDG.
22B
22C
22C3
22C1
22C2
DCT
22D
QUANTIZER
22E
I QUANT
22F
IDCT
22G
22H
VLC APPARATUS
23
BUFFER
24
S4
REAR ORIGINAL
22I1
FRONT ORIGINAL
22I2
22I
MOTION COMPENSATION
22J

FIG. 7

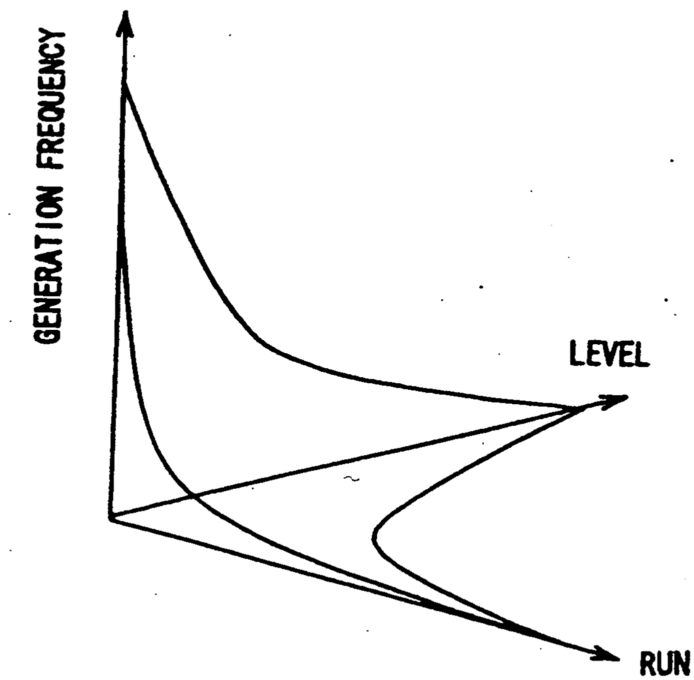

GENERATION FREQUENCY
LEVEL
RUN

FIG. 8

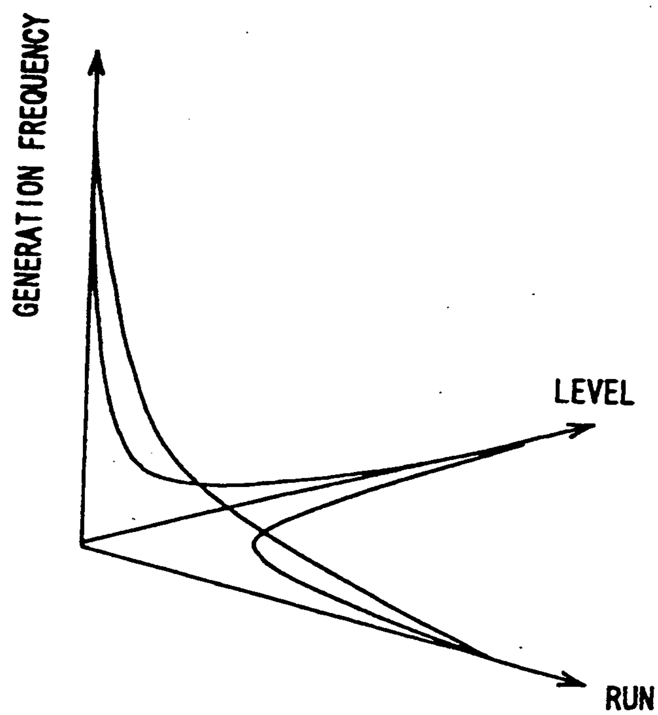

GENERATION FREQUENCY
LEVEL
RUN

FIG. 9

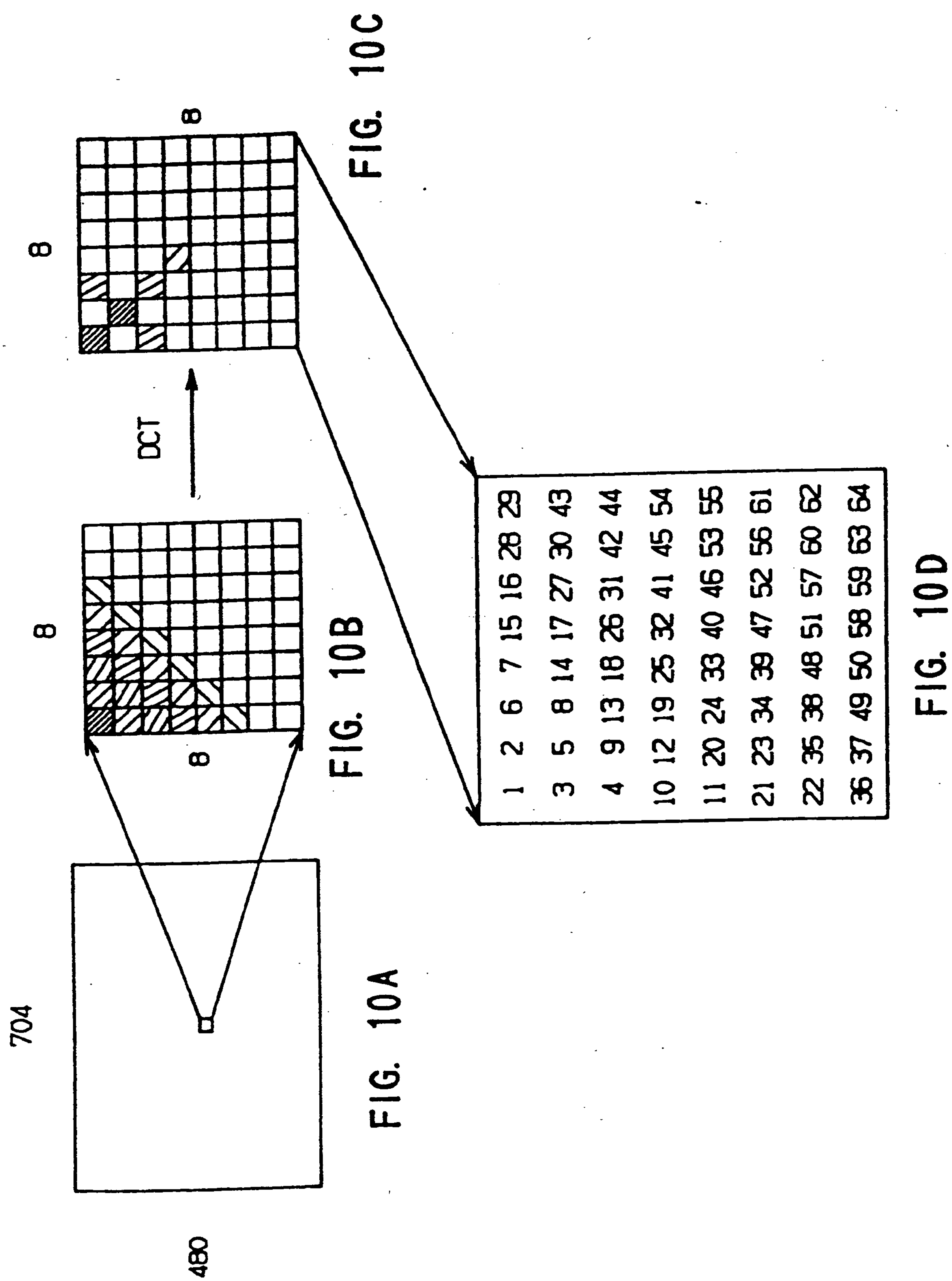


FIG. 10A

FIG. 10B

FIG. 10C

FIG. 10D

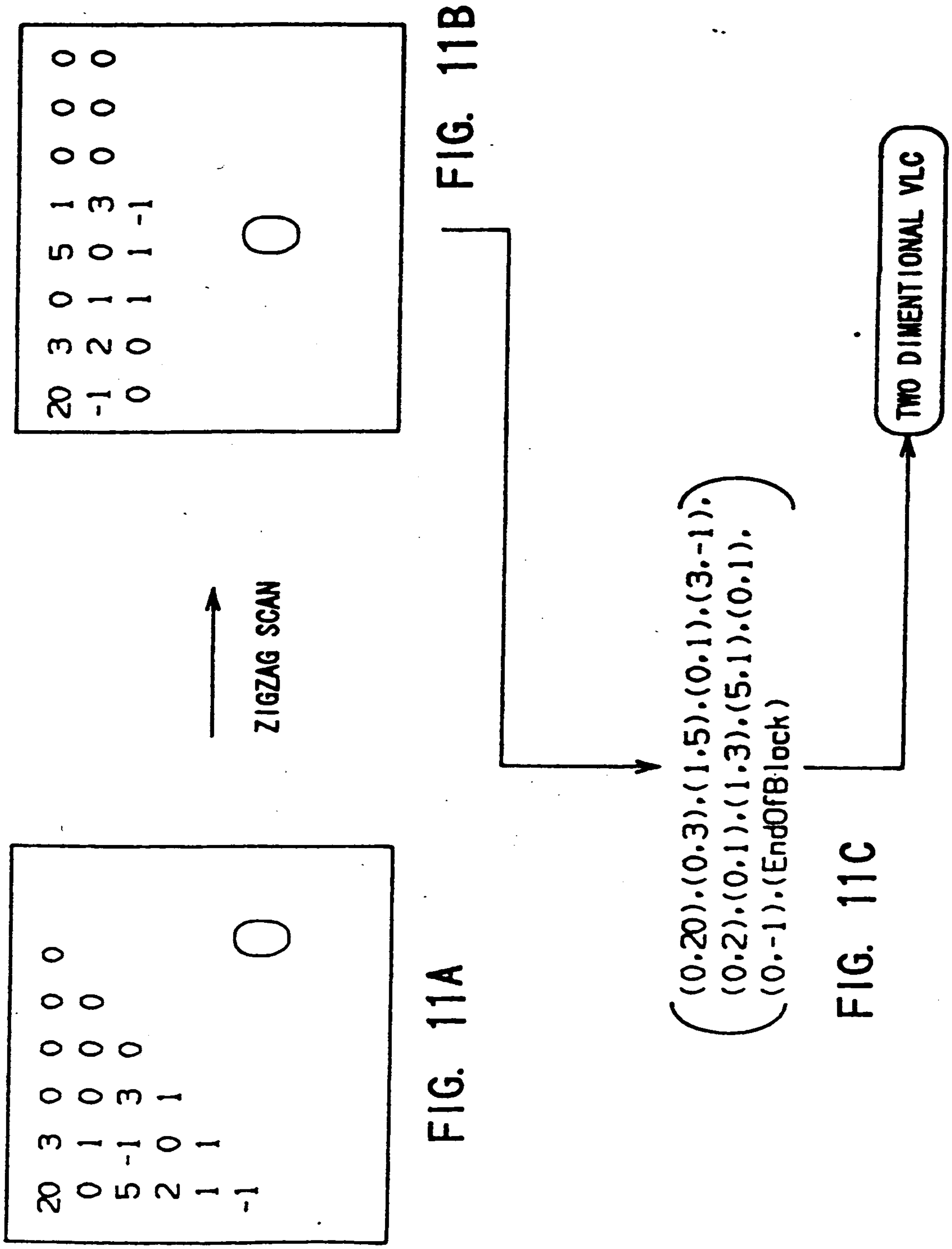


FIG. 11A

FIG. 11B

FIG. 11C

VLC Code	run	level
10	EOB	
11	0	1
011	1	1
0100	0	2
0101	2	1
00101	0	3
00111	3	1
00110	4	1
000110	1	2
000111	5	1
000101	6	1
000100	7	1
000110	0	4
0000100	2	2
0000111	8	1
0000101	9	1
000001	Escape	
00100110	0	5
00100001	0	6
00100101	1	3
00100100	3	2
00100111	10	1
00100011	11	1
00100010	12	1
00100000	13	1

FIG. 12

level

run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	3	5	6	8	9	9	11	13	13	13	13	14	14	14	14
1	4	7	9	11	13	14	14	16	16	16	16	16	16	16	17
2	5	8	11	13	14	20	20	20	20	20	20	20	20	20	20
3	6	9	13	14	20	20	20	20	20	20	20	20	20	20	20
4	6	11	13	20	20	20	20	20	20	20	20	20	20	20	20
5	7	11	14	20	20	20	20	20	20	20	20	20	20	20	20
6	7	13	17	20	20	20	20	20	20	20	20	20	20	20	20
7	7	13	20	20	20	20	20	20	20	20	20	20	20	20	20
8	8	13	20	20	20	20	20	20	20	20	20	20	20	20	20
9	8	14	20	20	20	20	20	20	20	20	20	20	20	20	20
10	9	14	20	20	20	20	20	20	20	20	20	20	20	20	20
11	9	17	20	20	20	20	20	20	20	20	20	20	20	20	20
12	9	17	20	20	20	20	20	20	20	20	20	20	20	20	20
13	9	17	20	20	20	20	20	20	20	20	20	20	20	20	20
14	11	17	20	20	20	20	20	20	20	20	20	20	20	20	20
15	11	17	20	20	20	20	20	20	20	20	20	20	20	20	20
16	11	17	20	20	20	20	20	20	20	20	20	20	20	20	20
17	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20
18	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20
19	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20
20	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20
21	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20
22	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20
23	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20
24	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20
25	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20
26	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20

FIG. 13

VLC Code	run	level
11	0	1
101	0	2
110	1	1
0111	EOB	
0110	0	3
01011	0	4
01010	0	5
01001	1	2
01000	2	1
00111	3	1
001101	0	6
001100	0	7
001011	4	1
001010	5	1
0010011	0	8
0010010	0	9
0010001	1	3
0010000	2	2
0001111	6	1
0001110	7	1
0001101	8	1
0001100	9	1
0001011	10	1
00010101	Escape	
00010100	0	10
00010011	0	11
00010010	0	12
00010001	0	13
00010000	1	4
00001111	3	2
00001110	11	1
00001101	12	1
00001100	13	1

FIG. 14

level

run	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
0	3	4	5	6	6	7	7	8	8	9	9	9	9	10	10	10	10	11	11	11	11	11	12	12	12	12	12	12	13	13	13	13	13
1	4	6	8	9	10	11	11	12	13	13	13	14	14	14	15	15	15	16	16	16	16	16	17	17	17	17	17	17	17	22	22	22	22
2	6	8	10	12	13	14	15	15	16	17	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
3	6	9	11	13	14	15	16	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
4	7	10	12	14	15	16	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
5	7	11	13	15	16	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
6	8	11	14	15	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
7	8	11	14	15	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
8	8	12	14	15	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
9	8	12	14	16	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
10	8	12	14	16	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
11	9	13	15	16	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
12	9	13	15	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
13	9	13	15	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
14	10	14	16	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
15	11	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
16	12	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
17	12	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
18	13	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
19	13	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
20	13	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
21	13	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
22	13	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
23	13	17	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22

FIG. 15

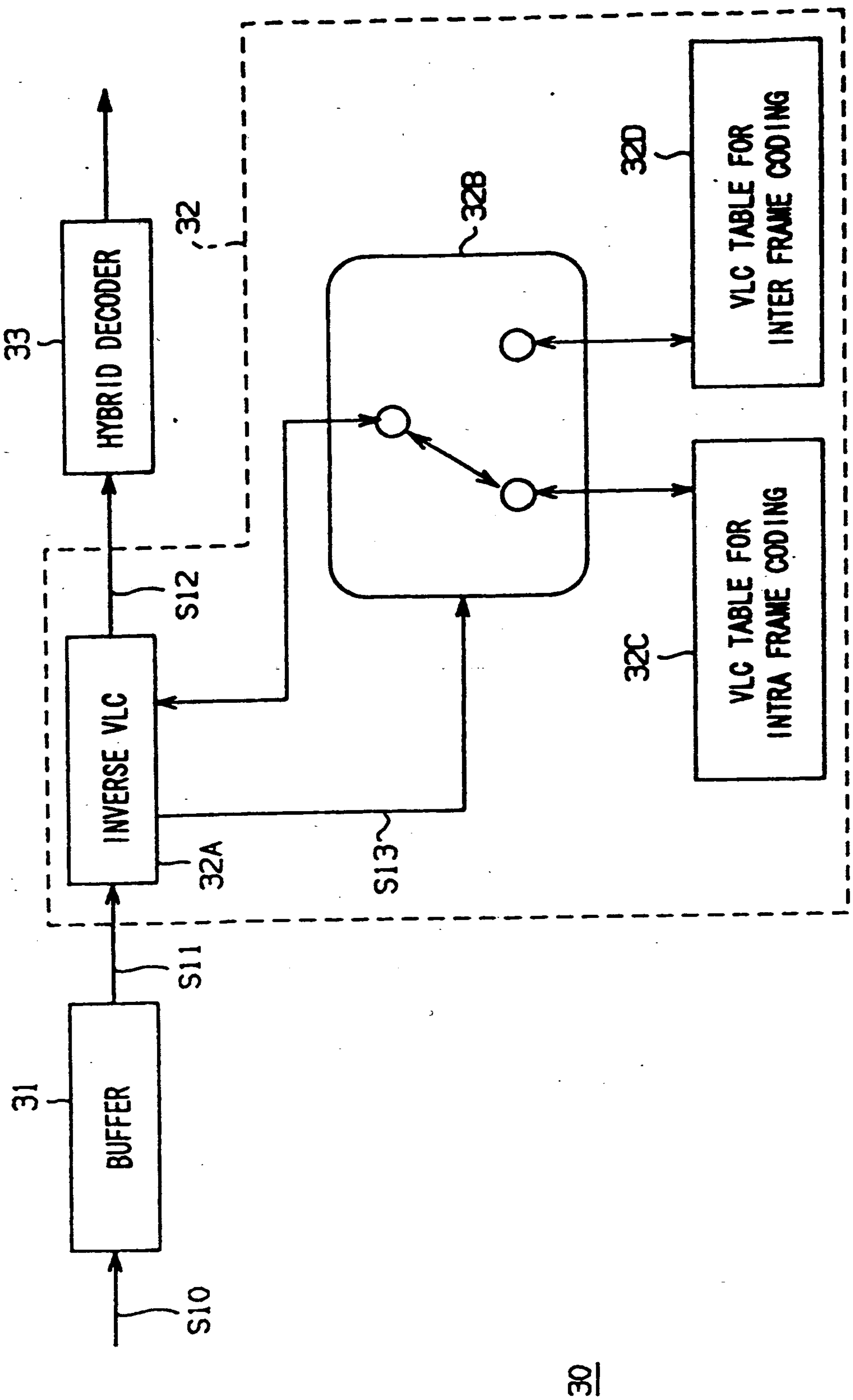

30
S10
31
BUFFER
S11
INVERSE VLC
32A
S12
HYBRID DECODER
33
32
S13
32B
VLC TABLE FOR
INTRA FRAME CODING
32C
VLC TABLE FOR
INTER FRAME CODING
32D

FIG. 16

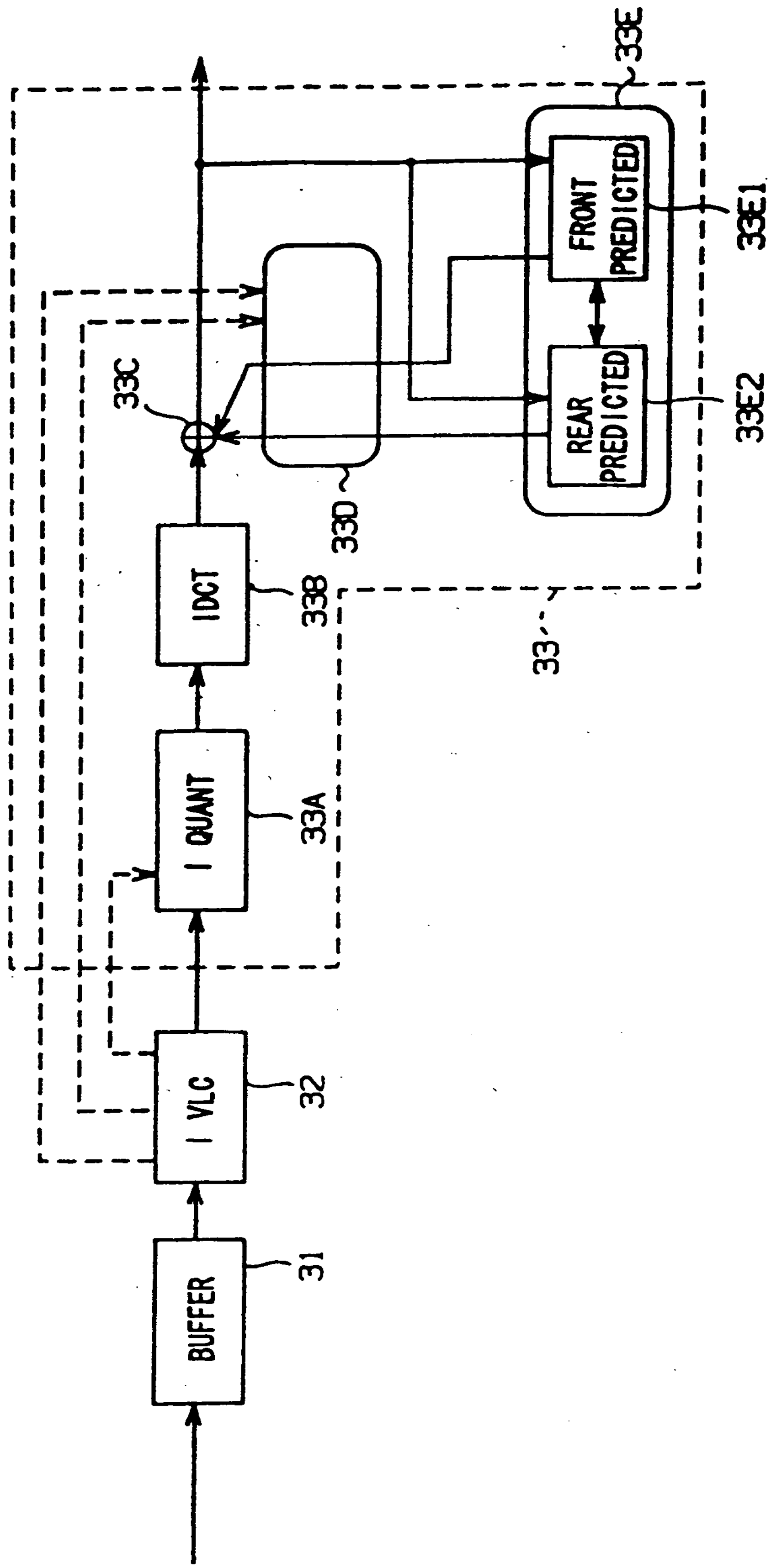

BUFFER
31
I VLC
32
I QUANT
33A
IDCT
33B
33C
33D
FRONT PREDICTED
33E1
REAR PREDICTED
33E2
33E
33

FIG. 17

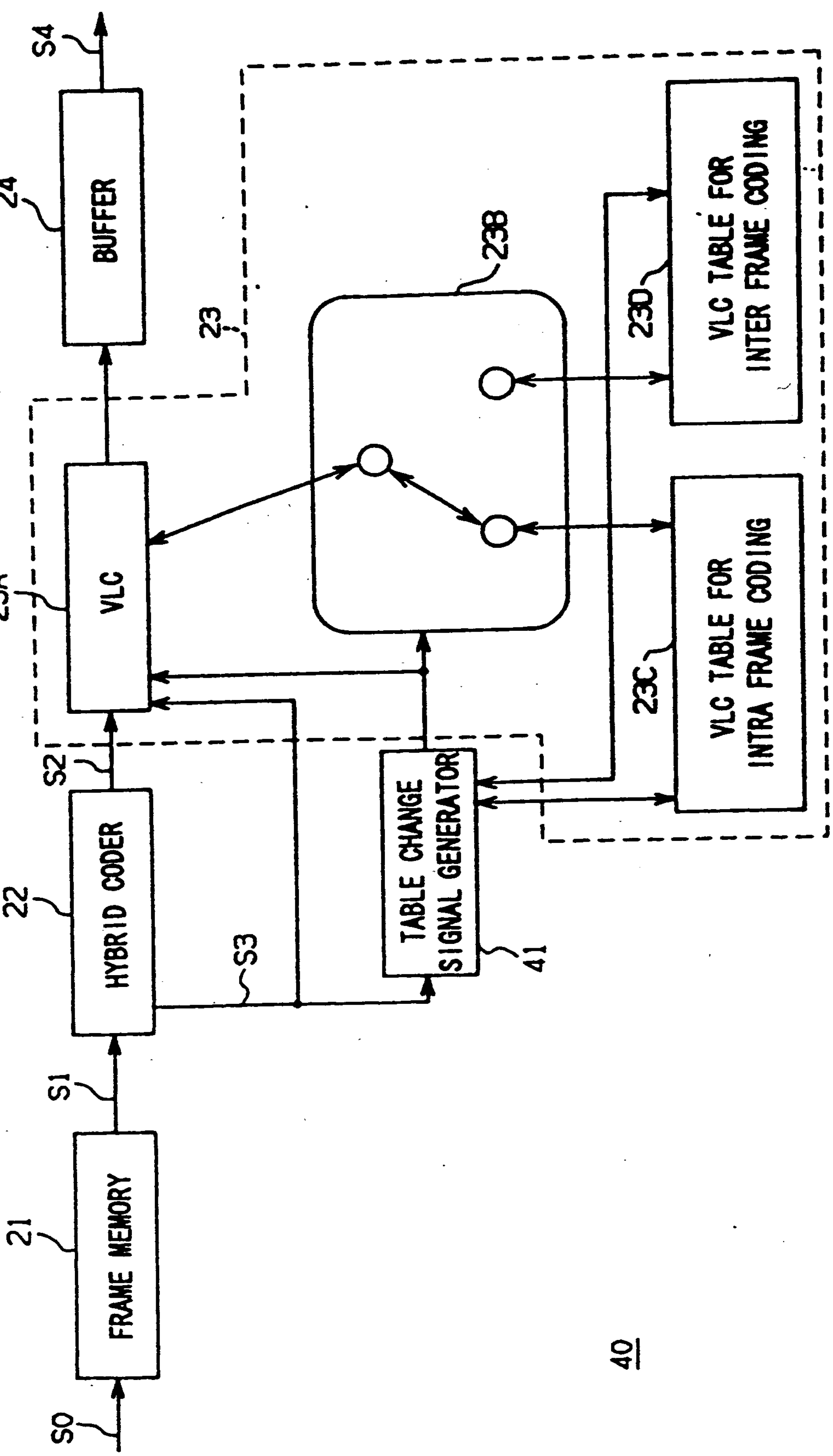

S0
21
FRAME MEMORY
S1
22
HYBRID CODER
S2
S3
23A
VLC
23
24
BUFFER
S4
23B
TABLE CHANGE SIGNAL GENERATOR
41
23C
VLC TABLE FOR INTRA FRAME CODING
23D
VLC TABLE FOR INTER FRAME CODING
40

FIG. 18

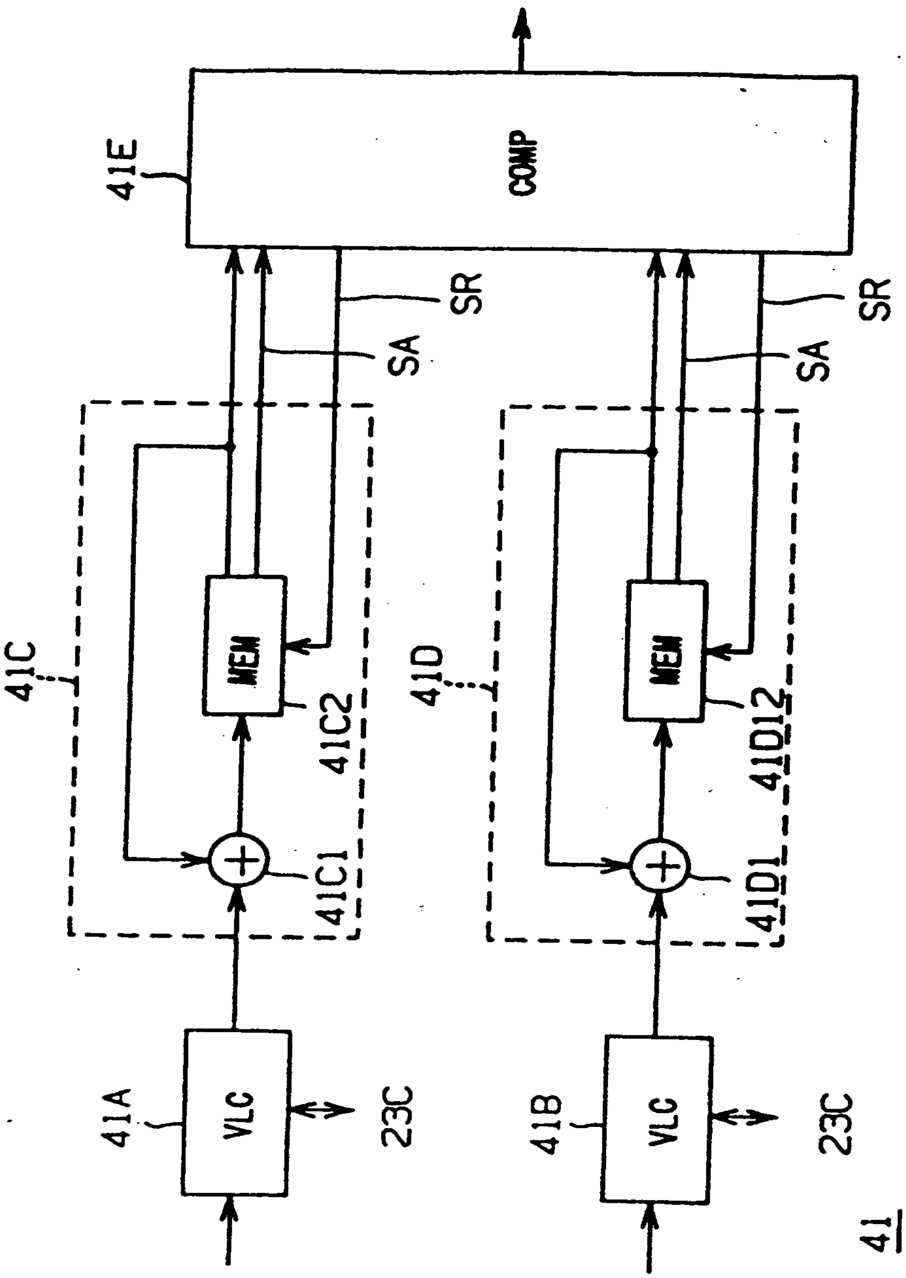

41E
COMP
SR
SA
41C
MEM
41C2
41C1
41A
VLC
23C
SR
SA
41D
MEM
41D12
41D1
41B
VLC
23C
41

FIG. 19

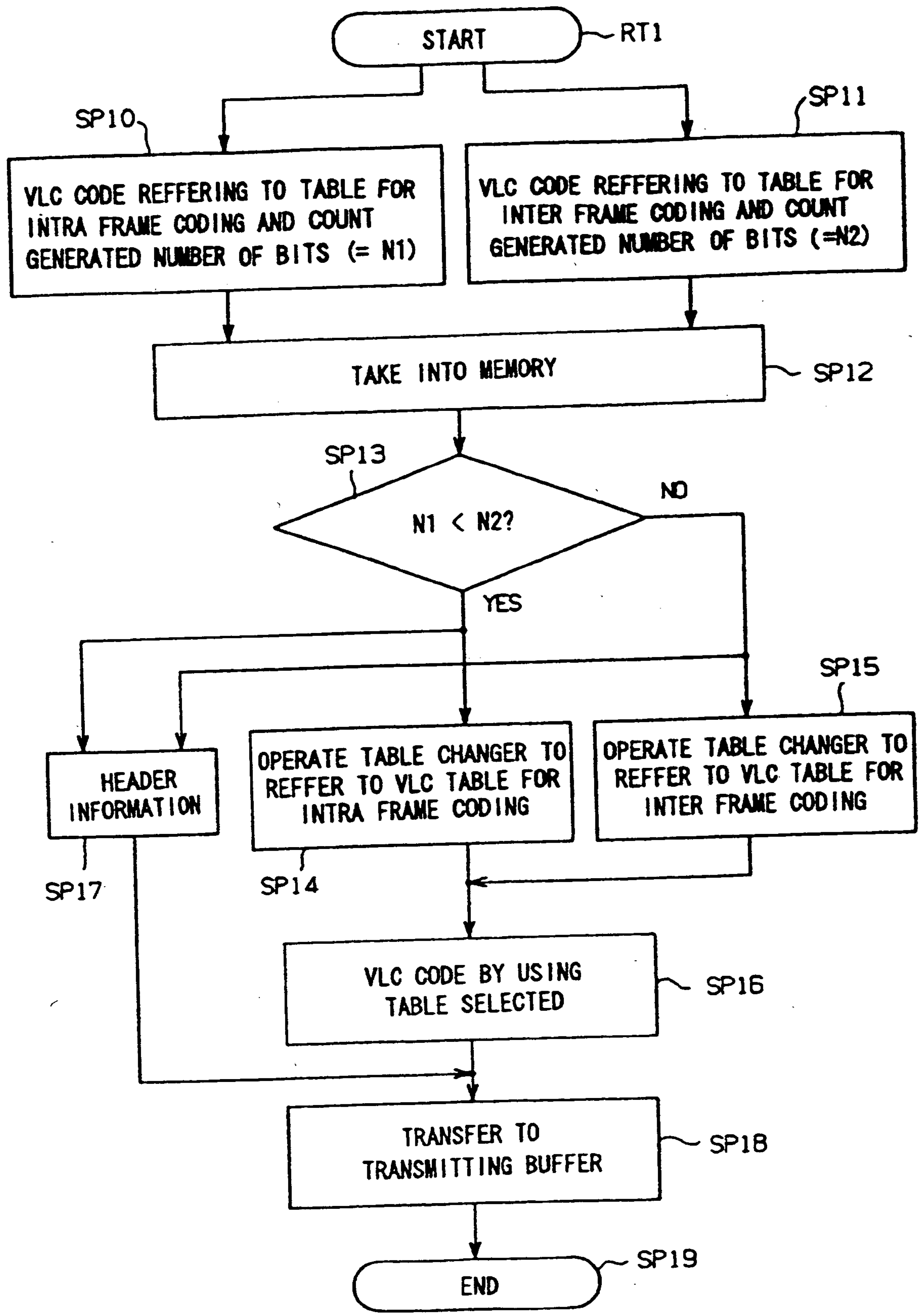

START
RT1
SP10
VLC CODE REFFERING TO TABLE FOR INTRA FRAME CODING AND COUNT GENERATED NUMBER OF BITS (= N1)
SP11
VLC CODE REFFERING TO TABLE FOR INTER FRAME CODING AND COUNT GENERATED NUMBER OF BITS (=N2)
TAKE INTO MEMORY
SP12
SP13
N1 < N2?
NO
YES
SP15
HEADER INFORMATION
OPERATE TABLE CHANGER TO REFFER TO VLC TABLE FOR INTRA FRAME CODING
OPERATE TABLE CHANGER TO REFFER TO VLC TABLE FOR INTER FRAME CODING
SP17
SP14
VLC CODE BY USING TABLE SELECTED
SP16
TRANSFER TO TRANSMITTING BUFFER
SP18
SP19
END

FIG. 20

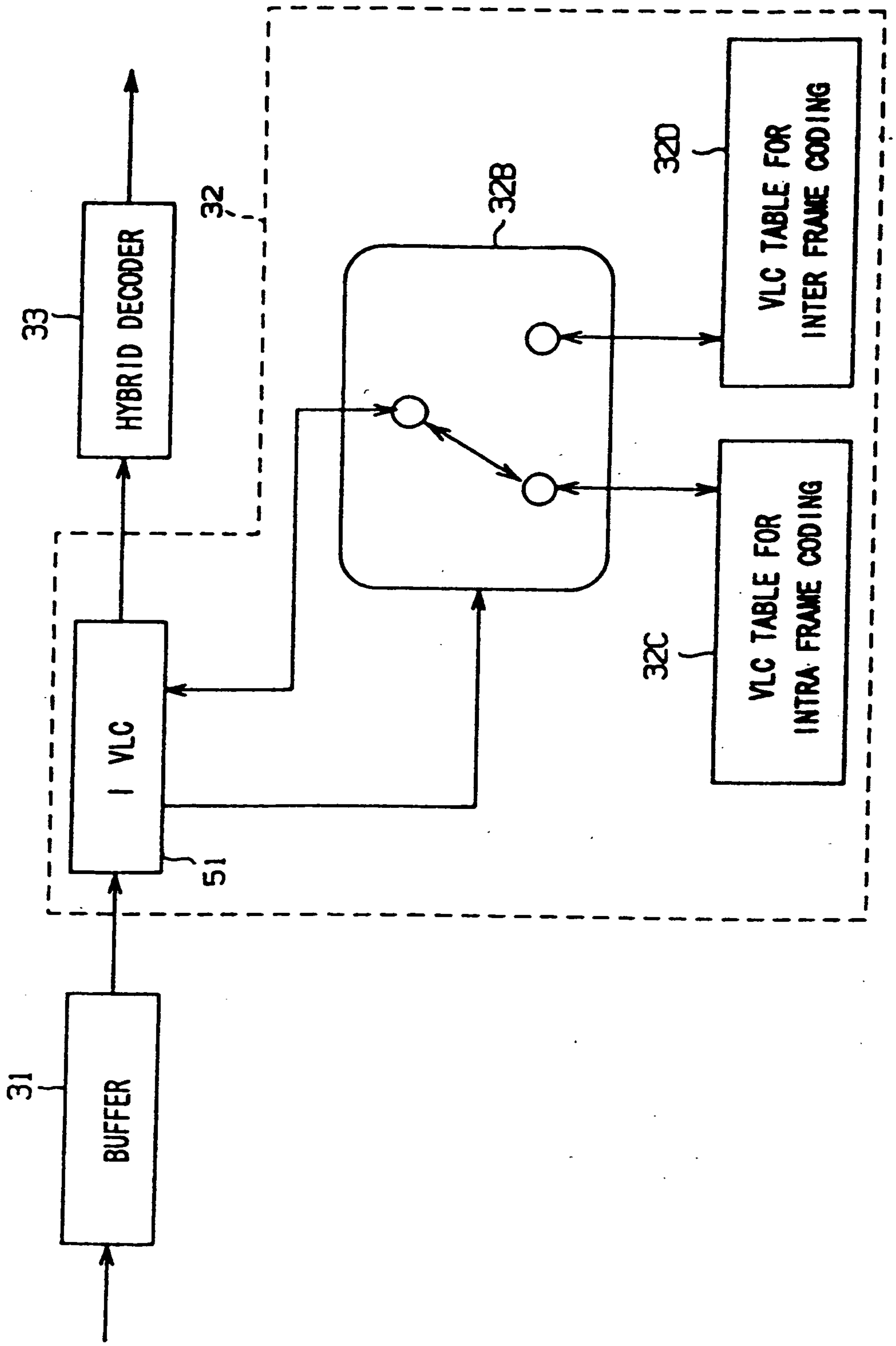

31
BUFFER
51
I VLC
33
HYBRID DECODER
32
32B
32C
VLC TABLE FOR
INTRA FRAME CODING
32D
VLC TABLE FOR
INTER FRAME CODING

FIG. 21

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(71) Applicant : **SONY CORPORATION**
6-7-35 Kitashinagawa
Shinagawa-ku
Tokyo 141 (JP)

(72) Inventor : **Okazaki, Toru, c/o Intellectual Pro. Div.**
Sony Corporation,
6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)
Inventor : **Yagasaki, Yoichi, c/o Intellectual Pro. Div.**
Sony Corporation,
6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)
Inventor : **Muramatsu, Yasuhiro, c/o Intellectual Pro. Div.**
Sony Corporation,
6-7-35 Kitashinagawa
Shinagawa-ku, Tokyo 141 (JP)

(74) Representative : **Cotter, Ivan John et al**
D. YOUNG & CO.
21 New Fetter Lane
London EC4A 1DA (GB)

(54) **Coding and decoding methods and systems.**

(57) Input data is efficiently variable length coded by using a variable length coding table selected from among a plurality of variable length coding tables (23C, 23D) in accordance with a coding efficiency. It is thus possible further to improve variable length coding efficiency as compared with a case using only one variable length coding table. As a result, when generating information content equal to that generated by using only one variable length coding table, it is possible to process quantized data with a smaller quantization size and further to improve the quality of information transmitted as coded data.

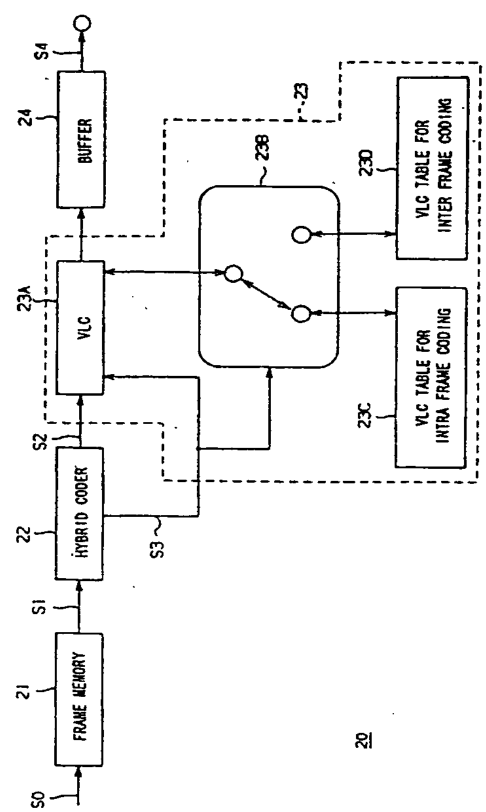

FIG. 5

EP 0 595 544 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 8349

Category	DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	INTERNATIONAL ORGANISATION FOR STANDARDIZATION - ISO/IEC JTC1/SC2/WG11, 13 November 1991 pages 1 - 74 SOURCE: MATSUSHITA 'MPEG Document 91/217' * page 3, line 1 - line 8 * * section 2.13 on page 13 *	1-16	H04N7/13 H04N7/133
X	EP-A-0 469 835 (CANON KABUSHIKI KAISHA) * claims 1,7; figures 5A,5B *	1,2,9,10	
X	PATENT ABSTRACTS OF JAPAN vol. 14, no. 553 (E-1010) 7 December 1990 & JP-A-02 237 368 (SHARP CORP.) 19 September 1990 * abstract *	1,9	
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 475 (E-1273) 2 October 1992 & JP-A-04 170 187 (OLYMPUS OPTICAL CO. LTD.) * abstract *	1-16	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, vol.38, no.1, February 1992, NEW YORK US pages XVIII - XXXIV G.WALLACE 'The JPEG still picture compression standard' * page XXIII, left column, line 26 - line 36; figures 1,2 *	1-16	H04N
P,X	EP-A-0 542 474 (AMERICAN TELEPHONE AND TELEGRAPH COMPANY) * page 7, line 30 - line 39 * * page 15, line 36 - page 16, line 10; figure 10 *	1-16	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 October 1994	Giannotti, P

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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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